Research Report 1423

Training Analysis and Design for Remedial Computer-Assisted Instruction for Tank Commanders

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Research Institute for the Behavioral and Social Sciences

March 1986

U. S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the
Deputy Chief of Staff for Personnel

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Research accomplished under contract
for the Department of the Army

Human Resources Research Organization

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARI Research Report 1423	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* TRAINING ANALYSIS AND DESIGN FOR REMEDIAL COMPUTER-ASSISTED INSTRUCTION FOR TANK COMMANDERS		5. TYPE OF REPORT & PERIOD COVERED Interim Report September 1984 - June 1985 6. PERFORMING ORG. REPORT NUMBER TR-TRD (VA)-85-2
7. AUTHOR(s) Knerr, C.M., Elder, B.L., Campbell, R., Harris, C.D., Stein, D.J., Sticha, P.J., Morrison, J.E., and Russo, R.P.		8. CONTRACT OR GRANT NUMBER(s) ARI Prime Contract MDA903-84-C-0479 SBA Contract No. 3-84-1-7190
9. PERFORMING ORGANIZATION NAME AND ADDRESS Human Resources Research Organization 1100 South Washington Street Alexandria, VA 22314-4499		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 2Q263743A794 3314 103
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue, Alexandria, VA 22333-5600		12. REPORT DATE March 1986 13. NUMBER OF PAGES 130
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)* --		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE --

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

--

18. SUPPLEMENTARY NOTES

Contracting Officer's Representative, D.M. Kristiansen.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Armor training	Computer-Managed Instruction
Computer-Assisted Instruction	Task analysis
Computer-Based Training	Training design and development

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Fort Knox Training Technology Field Activity (TTFA) is a cooperative activity of the Training and Doctrine Command (TRADOC), the United States Army Research Institute (ARI), and the United States Army Armor Center (USAARMC). Since its inception in November 1983, the mission of the TTFA has been the application of emerging technology to Armor school training. The initial focus of the Fort Knox TTFA is the Basic Noncommissioned Officer's Course (BNCOC) training M1 tank commanders (MOS 19K).

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The overall scope for this project produces the design, development, and evaluation of a computer-based course management (CM) system for the 19K BNCOC and computer-assisted instruction (CAI) for tasks prerequisite to the 19K BNCOC course.

The project consists of the following six tasks:

Task 1: Analysis and Design of the CM System.

Task 2: Analysis and Design of Remedial CAI.

Task 3: Development of CM System.

Task 4: Development of Remedial CAI.

Task 5: Implementation and Evaluation of CM System.

Task 6: Implementation and Evaluation of CAI.

This report describes the Task 2 activities undertaken to analyze the primary task-specific remedial training needs of students entering 19K BNCOC and design individualized interactive CAI to satisfy those needs.

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Department of the Army

March 1986

Army Project Number
2Q263743A794

Education and Training

ARI Research Reports and Technical Reports are intended for sponsors of R&D tasks and for other research and military agencies. Any findings ready for implementation at the time of publication are presented in the last part of the Brief. Upon completion of a major phase of the task, formal recommendations for official action normally are conveyed to appropriate military agencies by briefing or Disposition Form.

FOREWORD

The ARI Fort Knox Field Unit has been involved for approximately 10 years in the development of innovative approaches to training for the Armor community and for the Army as a whole. This effort has recently been given special emphasis through the formation of the Training Technology Field Activity (TTFA), a partnership among ARI, the Training and Doctrine Command, and the U.S. Army Armor Center. The purpose of the TTFA is to increase the effectiveness and efficiency of training through the application of appropriate new technologies.

This report ~~The work reported~~ here focuses on the development of computer-assisted instruction (CAI) for training tank commanders to man the new M1 Abrams Tank. Mid-grade noncommissioned officers selected for this course take a diagnostic test before training to determine if they are proficient on course prerequisites. Soldiers failing one or more prerequisite tasks are charged to become proficient, on their own time, early in the course.

In an effort to make both testing and remediation more efficient and effective, a CAI program that presents remedial instruction automatically was developed. This frees scarce instructor resources for concentration on new learning.

This report describes the analysis and design of a CAI-based diagnostic testing and remedial training program. A novel feature of the analysis was the conduct of a "cognitive" as well as a standard analysis of remedial tasks. The purpose of the cognitive analysis was to identify some of the basic knowledge structures and processes that underlie performance on the prerequisite tasks. This was accomplished through an indepth analysis of the task performance of a sample of soldiers who were representative of 19K BNCOC entrants. Of particular interest were data that indicated or implied specific knowledge deficiencies. Information about these knowledge deficiencies was then used as guidance for designing appropriate remedial instruction.

Edgar M. Johnson

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Technical Director

TRAINING ANALYSIS AND DESIGN FOR REMEDIAL COMPUTER-ASSISTED INSTRUCTION FOR TANK COMMANDERS

EXECUTIVE SUMMARY

Requirement:

To analyze the primary task-specific remedial training needs of students entering the MOS 19K Basic Noncommissioned Officer Course (BNCOC) and to design individualized interactive computer-assisted instruction (CAI) to satisfy those needs.

Procedure:

The analysis and design of the remedial CAI followed the guidance in TRADOC Regulation 350-7: A Systems Approach to Training. Tasks taught in BNCOC and tasks prerequisite to the course had been analyzed in previous work. Additional task information was collected in interviews with instructors and course managers. Diagnostic test data were collected on 1 year's course input to identify tasks frequently failed. Tasks were selected for CAI development based on diagnostic test results, importance rankings, need to perform the task on the tank or other equipment, and the anticipated availability of training devices to support diagnostic testing and remedial training.

Standard and cognitive task analyses were performed on the selected tasks to identify common errors, assess the relative ease in learning the tasks, and to infer cognitive structures from task interrelationships. The TECEP model (Training Effectiveness and Cost Effectiveness Prediction) was applied to the task level to determine the underlying skills and to prescribe the training design.

Following analysis of the primary task-specific remedial training needs, functional specifications for prescriptions of the training design and content were identified for each of the remedial tasks selected for CAI developments. Detailed training prescriptions were prepared for each of the selected CAI tasks.

Findings:

Analysis of the MOS 19K BNCOC diagnostic testing and remedial training requirements resulted in selection of five tasks for MicroTICCIT instructional authoring and delivery. The tasks are as follows:

Operate radio set.

Determine grid coordinates of a point on a military map using the military grid reference system.

Communicate usual visual signaling techniques.

Recognize and identify friendly and threat armored vehicles.

Establish tank firing positions.

Standard task analysis and TECEP produced training and testing designs for these tasks. Cognitive analysis provided detailed error analysis for the training designs.

Utilization of Findings:

Diagnostic tests and remedial training programs have been produced for delivery on a MicroTICCIT System II. The tests and programs will be used to train M1 Tank Commanders attending the 19K BNCOC course.

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Introduction

The Fort Knox Training Technology Field Activity (TTFA) is a cooperative activity of the Training and Doctrine Command (TRADOC), the United States Army Research Institute (ARI), and the United States Army Armor Center (USAARMC). Since its inception in November 1983, the mission of the TTFA has been the application of emerging technology in microcomputers, videodiscs, voice synthesis and recognition, and automated training devices to Armor school training. The initial focus of the Fort Knox TTFA is the Basic Noncommissioned Officer's Course (BNCOC) training M1 tank commanders (MOS 19K).

As part of its efforts to improve the efficiency and effectiveness of the 19K BNCOC, the Fort Knox TTFA has contracted with InterAmerica Research Associates, Inc. to develop computer-managed instruction (CMI) for tank commanders. InterAmerica is assisted in this effort by the Human Resources Research Organization (HumRRO) and by Interactive Television Company (ITC). The overall scope for this project produces the design, development, and evaluation of a computer-based course management (CM) system for the 19K BNCOC and computer-assisted instruction (CAI) for tasks prerequisite to the 19K BNCOC course.

The project consists of the following six tasks:

- **Task 1: Analysis and Design of the CM System.** This task analyzes the management needs of the 19K BNCOC and designs a computer-based CM system that will satisfy those needs.
- **Task 2: Analysis and Design of Remedial CAI.** This task analyzes the primary task-specific remedial training needs of students entering 19K BNCOC and designs individualized interactive CAI to satisfy those needs.
- **Task 3: Development of CM System.** This task develops and documents the CM system appropriate for application in 19K BNCOC and relevant to the CAI remedial training.

- **Task 4: Development of Remedial CAI.** This task develops and documents the CAI appropriate for providing prerequisite training for 19K BNCOC.

- **Task 5: Implementation and Evaluation of CM system.** This task refines the CM system based upon its implementation and evaluation during one session of 19K BNCOC.

- **Task 6: Implementation and Evaluation of CAI.** This task refines the CAI based upon its implementation and evaluation during one session of 19K BNCOC.

This report describes the activities carried out under Task 2, Analysis and Design of Remedial CAI. Major components of this task include the selection of prerequisite tasks requiring remedial CAI; analysis of these tasks to determine criticality, skill level, objectives, standards, performance steps, and existing training material; determination of guidelines for training design; and design specification of courseware. The body of this report describes the background for these activities and the methods used to carry them out. The major results are described in Appendix A, which presents the task analysis, diagnostic test design, and training design. The specific task-related learning guidelines are included as part of the training design. The general learning guidelines which apply to all tasks are described in the course design section of this report.

Background

The Army Training and Doctrine Command (TRADOC) and Army Research Institute (ARI) established Training Technology Field Activities (TTFA) to overcome training problems through applications of advanced technology. TRADOC headquarters set up a new activity, the Training Technology Activity (TTA). In conjunction with ARI, TTA determined that TTFA be located at three of the TRADOC proponent schools for Army training (Armor, Aviation, and Quartermaster). Each TTFA is directed by a consortium of representatives from TRADOC, the proponent school, and ARI. The proponent school is included to integrate, from the start, the users of the training and technology.

The first TTFA is located at Fort Knox, Kentucky. Its initial focus is on the Basic Noncommissioned Officers' Course (BNCOC) for the commander of the M1 Abrams tank (MOS 19K). The mission, as with subsequent TTFA, is to identify, coordinate, evaluate, and implement training research and technology in the Army.

The Fort Knox TTFA and 19K BNCOC

The BNCOC for the M1 tank commander at Fort Knox lasts over six weeks, during which the 19K students have administrative in-processing and diagnostic tests, remedial training if needed, training-to-train and NCO professionalism lessons, and common skills such as land navigation, communications, and maintenance. They learn skills unique to their MOS and vehicle, including gunnery (directing and conducting engagements, boresighting and zeroing, subcaliber and live fire gunnery) crew drills, and tactics. The final two weeks are devoted to situational exercises and field exercises.

Diagnostic Testing and Remedial Training for 19K BNCOC

BNCOC tests entering students on a sample of prerequisite tasks. The plan during design of BNCOC was to test prospective students in home stations. The tasks, at skill levels one and two, are prerequisites to the NCO tasks in BNCOC and should be in the repertory of the BNCOC student. Those who failed tasks were to train to proficiency before entering the course.

In practice, the diagnostic tests are administered at the start of BNCOC, and students who fail must train outside of course time to acquire the skills (e.g., study hall). No time is allotted to train these skills during the course, but instructors must devote time and effort to their training and retesting (e.g., helping students obtain study materials and present off-duty instruction on tasks that have no self-study materials).

Initial results indicate that many BNCOC students fail some of these prerequisite task tests. BNCOC needs self-administered, computer-managed training materials for use outside class time for the students to acquire the prerequisite skills without adding to demands on instructor time and resources.

ARI, through a contract to HumRRO, is applying the Army's Systems Approach to Training (SAT) to the 19K BNCOC. (Drucker, Hannaman, Melching, and O'Brien, 1984; Drucker and O'Brien, 1985; Morrison, 1985; Morrison, Drucker and O'Brien, 1984). The SAT project reviews the available job and task analyses, identifies additional training requirements (including additional prerequisites), designs the 19K BNCOC training program, and develops some training support materials (e.g., lesson plans). The SAT project does not, however, develop courseware for the training. An objective of this project is, therefore, to develop microprocessor-based,

self-administered instructional courseware for a selected set of the 19K BNCOC remedial tasks. ARI selected MicroTICCIT as the primary testing and instructional system. MicroTICCIT is a Hazeltine Corporation hardware and software system designed to deliver ADAPT courseware development and delivery for medium scale computer-based training efforts. The system is discussed more fully later in this report. Figure 1 shows a list of MicroTICCIT components.

As currently applied, BNCOC students are tested during the first two days of the course on the following 14 tasks:

- Identify and Explain Use of Main Gun Ammo
- Maintain the M240 COAX Machinegun
- Perform Operator Maintenance/Set Headspace and Timing on Cal .50 Machinegun
- Remove/Disassemble/Assemble/Install 105mm Breechblock
- Load/Unload Main Gun
- Apply Loader's Misfire Procedures
- Apply Gunner's Misfire Procedures
- Engage Targets Using Precision Fire
- Engage Targets Using Battlesight
- Adjust Fire From a Subsequent Fire Command
- Prepare Gunner's Station for Operation
- Call for/Adjust Indirect Fire
- Determine Six Digit Grid Coordinates
- Operate Driver's Station

The history of how these tasks were selected as prerequisites is not precise; however, it appears that they were subjectively selected by the primary training developer during initial course development based on his own experiences and input from his coworkers. They selected skill level

Eclipse S/20 Microprocessor
50 Megabyte disk
15 Megabyte tape drive
D210 Dasher, Model 6242 (Data General console)
D210 Dasher Keyboard, Model 6246A
Desk and Pedestal
Modem, Model 490190-A
IBM DMA Board
Associated cabling

4 MicroTICCIT Workstations consisting of:

IBM Personal Computer, Model 5150*
Network Controller*
Sony Video Monitor Model 1270
MicroTICCIT display board and videodisc overlay board
MicroTICCIT keyboard
Light Pen
Nestar ARCNET Local Area Network
Sony Disc Player

The system also includes the following software:

Data General Disk Operating System (RDOS)
TICCIT Operating System (MPOS)
ADAPT courseware authoring language
ALGOL programming language

*One terminal services as the Network Controller and has one disk drive; the other three workstations have 2 disk drives.

Figure 1. MicroTICCIT System II Components

one and two tasks that their experience showed were likely to be failed by prospective tank commanders. This approach allowed the developers to include often failed tasks in the course as prerequisites which would not ordinarily be taught in BNCOC (policy does not allow for training lower skill level tasks as part of the curriculum). While this was an adequate short-term solution, ARI directed that this project reconsider the selection of prerequisite tasks for diagnostic testing.

Method and Results

Analysis and Design of Remedial CAI

The approach for achieving the computer-assisted instructional objectives is based on TRADOC Regulation 350-7, A Systems Approach to Training (1982), which specifies the major training design and development phases: Analyze, design, develop, implement, and evaluate. Recent methods for cognitive task analysis were incorporated to explore the underlying skills and learning strategies required in the remedial tasks. The instructional design and development was tailored to the special needs of videodisc-based instruction and to MicroTICCIT authoring and instructional delivery. The current HumRRO project that applies the systems approach to training (SAT) to analyze the 19K30 BNCOC course provides much of the basic material for the analysis and design subtasks which are described in more detail below.

Analysis of CAI Requirements

Analysis of the primary task-specific remedial training needs, to determine those most critical for the entering 19K30 students, starts with traditional task analysis and incorporates methods to analyze underlying skills and establish functional requirements. The specific activities related to the analysis are outlined and discussed in the following pages.

Review Task Documentation

The tasks taught in BNCOC as well as the tasks prerequisite to the course have been the subject of in-depth analysis in the ARI-HumRRO SAT study. An interim report of this study (Drucker, et al., 1984) formed the basis of what the design of the BNCOC course will be in the future. Although the results of this study have not, as yet, been approved, they served as a basis for much of the documentation of the history, objectives, organization and future of the BNCOC course.

The SAT study identified two kinds of tasks as prerequisites for the 19K30 duty position and for the BNCOC course. First are skill level one and two tasks that must be mastered before a skill level three task can be performed; for example the skill level one task, "Determine the Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System," is considered prerequisite to the BNCOC task "Determine a Location on the Ground by Terrain Association." The second category of tasks is not clearly prerequisite to skill level three tasks but is prerequisite to the BNCOC course. During BNCOC, the student must function as loader, driver and gunner as well as tank commander during gunnery, situational training exercises and field exercises. Therefore, he must possess the level one and two skills required by those positions; for example, "Load the 105mm Main Gun" and "Prepare Gunner's Station for Operation."

Additional task documentation was obtained from the course supporting materials, consisting of:

- Course Program of Instruction
- Task Instructional Lesson Plans
- Prerequisite Task Diagnostic Tests
- Prerequisite Task Remedial Lesson Plan

These materials identified the specific tasks now being taught, the scope of those tasks, and the scope and content of current prerequisite testing.

Finally, documentation was gathered on specific tasks. The main source of task information was the Soldier's Manual (SM) FM 17-19K 1/2/3. This task information was supplemented as necessary by technical manuals, field manuals, and other selected material providing more detailed information about specific tasks.

Interview Instructors and Course Managers

Under HumRRO's SAT project, interviews were conducted concerning 19K BNCOC content, design and development with the following individuals and organizations:

- Analysts, Individual Training Branch, Directorate of Training and Doctrine (DOTD)
- Analysts, Collective Training Branch, DOTD
- Chief, Training Design/Development Branch, DOTD
- Instructors, 19K BNCOC
- Students, BNCOC Course
- Subject matter experts (SME) in various departments within the Armor School

Access to these previous interview results precluded the requirement for formal structured interviews of BNCOC instructors and others for the purpose of determining training requirements for prerequisite tasks. However, during the observation of diagnostic testing, informal interviews were conducted with BNCOC instructors and students. Additionally, follow-up and telephone interviews were conducted to answer specific questions during the analysis.

Review Historical Diagnostic Test Results and Other Relevant Data

Diagnostic test data were obtained on 41 19K BNCOC students (approximately one year's class load) on 13 prerequisite tasks. One task, Operate Driver's Station, had been infrequently tested and insufficient data were available. The results of this testing are shown in Table 1. The results show a wide variation in performance. The first three tasks are so consistently passed that to continue testing them on a regular basis is probably an inefficient use of test resources. On the other hand, the task with the lowest pass rate (Call for/Adjust Indirect Fire) is so consistently failed that this, too, reflects a questionable use of testing

Table 1: First Time Pass Rates Diagnostic Test - 19K BNCOC

TASK	% GO
1. Identify and Explain Use of Main Gun Ammo	95.12
2. Apply Loader's Misfire Procedures	90.24
3. Prepare Gunner's Station For Operation	90.24
4. Load/Unload Main Gun	87.81
5. Engage Targets Using Battlesight	87.81
6. Maintain the M240 COAX Machinegun	85.37
7. Adjust Fire Using Subsequent Fire Command	78.05
8. Apply Gunner's Misfire Procedures	75.61
9. Disassemble/Assemble Breechblock	73.17
10. Engage Targets with Precision Fire	73.17
11. Perform Operator Maintenance/Set Headspace and Timing on .50 Cal Machinegun	56.10
12. Determine Six Digit Coordinates	46.34
13. Call For/Adjust Indirect Fire	4.88

Note
N = 41. Sample reflects data available as of October 1984.

time. If this task is critical, consideration should be given to its inclusion in the course content for instruction.

Identify Remedial Tasks

ARI directed that the project select from four to six prerequisite tasks that could be both tested and remediated using the computer-assisted instruction (CAI) on the MicroTICCIT system. In addition, ARI ordered the priorities for the selection, design and training development of the remedial tasks on the basis of four criteria: (1) diagnostic test results, (2) important rankings, (3) need to perform the task on the tank or other equipment, and (4) the anticipated availability of training devices to support diagnostic testing and remedial training. To insure that all appropriate tasks were considered, a prerequisite task domain was assembled using all tasks from the following sources:

- Current Diagnostic Tests
- SAT Prerequisite Task Lists (The SAT study designated prerequisite tasks in two categories. The first contained tasks not taught in BNCOC but considered derivitive from existing or recommended BNCOC tasks. The second contained tasks that must be performed in duty positions other than tank commander).
- Soldier's Manual Specified Prerequisites

This analysis assembled approximately 70 tasks. From this domain HumRRO selected approximately 20 tasks as a basis for CAI task selection. This initial selection used the following guidelines:

- Eliminate tasks incorporated into BNCOC by the SAT recommendations.
- Eliminate tasks with high pass rate experience.

- Eliminate tasks that could not be directly related to a skill level three task taught or an activity performed in BNCOC.
- Concentrate on tank related tasks necessary to crew performance during BNCOC with emphasis on gunnery and field exercises.
- Continue emphasis on tasks with safety and damage implications.

A member from the SAT analysis staff and a staff member from this project assembled independent lists and then resolved differences. Both staff members used input from previous interviews and surveys as well as their own knowledge of the course and the tasks. The consolidated list is shown in Table 2.

From the 21 tasks selected as candidate prerequisite tasks, a further screening process was applied to determine CAI suitability. The general approach was that the task must be both testable and trainable using MicroTICCIT technology. Further screening considerations were:

- Eliminate gunnery engagement tasks: Other technologies (MK60, UCOFT, ICOFT, DETRAS, TGMTS) are better suited to these tasks than the MicroTICCIT.
- Eliminate machinegun procedural tasks: Tasks that deal with operator maintenance, clearing, loading and function checks of the caliber .50 and M240 machineguns are best performed on the guns themselves. Both testing and training should be done with hands-on equipment.
- Eliminate in-tank procedural tasks: Much like the machinegun tasks, tasks such as Prepare Gunner's Station for Operation and Load/Unload the Main Gun are best performed on the actual equipment due to either the complexity of the task or the physical feedback required during performance. While certain learning could take place on MicroTICCIT, testing fidelity would, in many cases, be degraded.

The results were six candidate MicroTICCIT tasks: Determine six digit grid coordinates, Communicate using visual signalling techniques, Recognize and identify friendly and threat armored vehicles, Establish tank firing positions, Troubleshoot the M1 tank driver control panel warning and caution lights, and Evade ATGM.

Table 2: Proposed BNCOC Prerequisite Tasks

	TASK TITLE
1.	Engage Targets With the Main Gun From Gunner's Station on an M1 Tank.
2.	Prepare Gunner's Station for Operation on an M1 Tank.
3.	Engage Targets With the M240 Machinegun From the Gunner's Station on an M1 Tank.
4.	Maintain a Caliber .50 M2 HB Machinegun.
5.	Clear a Caliber .50 M2 HB Machinegun to Prevent Accidental Discharge.
6.	Perform Operator Maintenance on an M240 Machinegun.
7.	Clear an M240 Machinegun to Prevent Accidental Discharge on an M1 Tank.
8.	Start/Stop the Engine of an M1 Tank.
9.	Install/Remove an M240 Coax Machinegun on an M1 Tank.
*10.	Determine the Grid Coordinates of a Point on a Military Map using the Military Grid Reference System.
*11.	Communicate Using Visual Signalling Techniques.
*12.	Establish Tank Firing Positions.
*13.	Operate Radio Set AN/VRC-64.
14.	Send a Radio Message.
15.	Secure Gunner's Station in an M1 Tank.
16.	Decontaminate Equipment Using ABC/M11.
17.	Load/Unload the 105mm Main Gun on an M1 Tank.
18.	Troubleshoot the M1 Tank Using Driver's Control Panel Warning and Caution Lights.
19.	Operate Intercommunications Set AN/VIC-1 in an M1 Tank.
*20.	Recognize and Identify Friendly and Threat Armored Vehicles.
21.	Evade ATGM.

*Indicates tasks selected for MicroTICCIT development.

The procedure and the selected MicroTICCIT tasks were briefed to the NCO Academy and BNCOC staff, TTFA members, USAARMS, DOTD and ARI. While there was general acceptance of the procedure used and of five of the six tasks presented, BNCOC staff indicated the need to test a radio task. As "Evade ATGM" is presently included in the BNCOC POI, it was deleted in favor of the task, "Operate Radio Set." While no firm priorities were established for the six tasks, the review panel directed that the task "Troubleshoot the Tank Driver's Panel" receive the lowest priority. Since contract resources only allow development of materials for five tasks, the troubleshooting task was deleted. This deletion produced the following list of tasks for training development:

- Determine grid coordinates of a point on a military map using the military grid reference system.
- Communicate using visual signalling techniques.
- Recognize and identify friendly and threat armored vehicles.
- Establish tank firing positions.
- Operate radio set.

Perform Standard Task Analysis

We applied traditional task analysis techniques to the selected tasks to determine the criticality, skill level, and length of conventional instruction through analysis of the objectives, standards, performance steps, and existing training materials. The results of this task analysis and training design are presented in Appendix A.

Perform Cognitive Task Analysis

The performance of typical course entrants on the five prerequisite tasks was analyzed in detail. The purposes of the analyses were threefold: to identify common errors, to assess the relative ease in learning the tasks, and to infer cognitive structures from task interrelationships. The structural analyses were similar to the methods used by Morrison (1984) to study procedural tasks. Analogous methods for deriving the structure of memory were developed for analysis of some of the present knowledge-based tasks. A detailed description of the methods and results from the analyses may be found in Appendix B. A summary of the results and their implications for training development is provided below.

Prepare/Operate the FM Radio Sets. Previous analyses of the radio task (Morrison, 1982) indicated that soldiers commit few errors while executing this task. Furthermore, a structural analysis of performance indicated that soldiers organize their memory for task elements around the separate presentations on the crewman's station, the audio frequency amplifier, and the radio transmitter.

Identify Friendly and Threat Armored Vehicles. The performance results indicated that vehicle identification is a difficult task, although the subtask of identifying vehicles as friend or threat was probably less difficult than the subtask of identifying vehicles by nomenclature. Furthermore, the results showed that soldiers did not improve in performance over the two test trials. In sum, the data indicated that this task, perhaps more than any other prerequisite task, requires systematic instruction.

The structural analysis indicated that the difficulty of identifying vehicles by nomenclature was partly due to some specific confusions within either the threat or friendly category. Clusters of confusions were based

on either perceived similarity in appearance, similarity in nomenclature, or both. Training must emphasize the attributes that distinguish often confused vehicles. A possible training solution would be to present frequently confused vehicles together in clusters so that the student may see those attributes that distinguish frequently confused vehicles.

Communicate Using Visual Signalling Techniques. In contrast to recognizing armored vehicles, soldiers improved in recognizing visual signals across the two test trials. This improvement suggests that visual signals may be relatively easy to learn. However, recognition performance on tactical signals was clearly inferior to performance on ground guiding signals. The difference between types of signals was related to experiences that soldiers have had in their unit, the 2/6 Cavalry Squadron. The mission of 2/6 is unlike other armor units in that they are specifically charged with supporting training and demonstration activities at the Armor Center. They are familiar with signals used to ground guide vehicles because they guide vehicles around post on a daily basis. On the other hand, compared to other types of units, these soldiers do not get as much field training opportunities, where they would become familiar with tactical signals.

The confusion data showed a pattern similar to the previous vehicle recognition data. That is, soldiers tended to cluster signals that were either similar in appearance, similar in definition, or both. The training prescription is also the same. That is, training should emphasize the differences between frequently confused signals. A similar training strategy wherein signals are presented in clusters is suggested.

Determine Grid Coordinates. Despite differences in the manner in which soldiers executed the task, soldiers were generally accurate in determining coordinates and identifying features. Nevertheless, analysis

revealed some errors soldiers are likely to commit while performing this task. For instance, the most likely error was a reversal of the north-south and east-west coordinates. This error and the others detailed in Appendix B could be used to identify points to emphasize during instruction and possible lures for multiple choice test items.

Establish Tank Firing Positions. The results indicated that soldiers remember this task as a set of conceptual knowledges and rules rather than as a procedure. Overall, soldiers performed fairly well on the knowledge test. Especially notable was the fact that there were virtually no errors either in identifying primary, alternate, and supplementary positions or in identifying hull-down or turret-down/hide positions.

A closer examination of soldier responses indicated that some of the errors were due to soldiers' misinterpreting the question. This experience emphasizes the fact that test items must be written with great care. Also, it is important that subject matter experts review the material carefully to see if each knowledge component is correct from a military point of view.

Design of CAI for Remedial BNCOC Training

Prescription of Training Device

HumRRO's recent review of models for training prescription and design indicated that the one best for the needs in this instance is the Training Effectiveness and Cost Effectiveness Prediction (TECEP) method, which is also incorporated into the Army's procedures for SAT (Knerr, Nadler, & Dowell, 1984).

TECEP translates task descriptions and learning principles into prescriptions for training. The task descriptions (from traditional task analysis) are used to categorize the tasks; the categories differ somewhat over the editions of TECEP, but the categories used in the Army's Model are:

Mental	*Identify objects and symbols*
	Recalling information
	Discriminating, detecting, monitoring
	Classifying, recognizing patterns
	Rule-learning and using
	Decision-making
Physical	Gross motor skill
	Responsive motor skill, steering, guiding
	Positioning movements, recalling procedures
	Voice communicating

Classification of the tasks into the TECEP categories leads to training prescriptions by applying the learning guidelines and instructional algorithm supplied in the TECEP model. The rules for the training prescriptions are based on the task characteristics, trainee ability levels, and training phase. Some learning guidelines apply to all of the task types, while others apply only to tasks within a specific category.

Our previous use of TECEP indicated the need to categorize skill types at the task element (step) level because the tasks encompassed several types of skills. However, TECEP did not reveal differing task characteristics at the task element level for the selected remedial tasks. Therefore, we used TECEP at the task level to determine the underlying skills and to prescribe the training design.

The TECEP learning guidelines and algorithms specify for each type of task the design considerations, including practice, feedback and reinforcement, guidance and prompts, learning strategies (e.g., mnemonics, imagery), and changes in the training design to enhance various stages of learning. We determined these learning guidelines for each skill type identified, and sequenced the remedial tasks into a complete training package. We limited the design to the amount of time available to the students to use the CAI (e.g., in study hall).

Table 3 lists the remedial tasks selected for training on MicroTICCIT and the TECEP learning categories for each task.

An analysis of the TECEP Learning guidelines revealed certain training specifications that are common across categories and apply to the instructional design of any task. These common specifications were combined into the following set, labeled General Learning Guidelines:

Table 3. Remedial Tasks and Learning Categories

TASKS	TECEP LEARNING CATEGORIES
Prepare/Operate FM Radio Sets	Rule Learning and Using
Determine Grid Coordinates	Rule Learning and Using
Communications Using Visual Signalling Techniques	Rule Learning and Using Classifying and Recognizing Patterns
Recognize and Identify Friendly and Threat Armored Vehicles	Classifying and Recognizing Patterns Recalling Bodies of Knowledge
Establish Tank Firing Positions	Rule Learning and Using

- Specify learning objectives
- Relate learning to job
- Provide for individualized training
- Provide visual aids and mnemonics
- Provide rewards
- Provide knowledge of results
- Provide practice

The following paragraphs explain, under the heading of each guideline, how the training designs of the BNCOC remedial tasks will meet these general training requirements.

Specify learning objectives. Each task (lesson) contains a MicroTICCIT text page on which is given the lesson objective and the objective(s) of any required segment(s). These objectives are taken from the Soldier's Manual of Common Tasks. The beginning of the instruction, whether presented by video or MicroTICCIT pages and graphics, describes the task to be learned.

Relate learning to job. The instruction for each task is based on information gathered from Army field and technical manuals. The setting, whether shown by video or MicroTICCIT graphics, will be in a military context. Props for the instruction, examples, practice, and tests will be photographic representations of actual equipment, realistic models, or realistic graphic depictions.

Provide for individualized training. The interactive networking for the CAI will assure individualized training. No two soldiers will take the same amount of time to complete a lesson; nor will their progress through a lesson necessarily take the same form. Each lesson allows ease of movement between and within the various subparts. The lesson menu provides a choice of any available part of the lesson or the option to quit the lesson.

When videodisc instruction is used, movement will be limited for two reasons: (1) videodisc instruction is considered a unit of information which is best seen in its entirety; and (2) presently, the system cannot determine on which frame the videodisc is stopped, which makes it difficult to allow random stops or backing up.

The test component of each lesson is completely restricted. Once the soldier has selected the test from the menu, he must complete the test before he can move to another part or quit the lesson.

Provide visual aids and mnemonics. This guideline suggests nine aids to help relate the material to the learning task: diagrams, pictures, charts, graphs, rhymes, acronyms, key words, common associations, and mnemonics. For each task, only a subset of the nine aids is appropriate for use. A preliminary review of the remedial tasks indicates that all five could benefit from the use of pictures, key words, common associations, and mnemonics. Diagrams can be useful for Determine Grid Coordinates, Recognize and Identify Friendly and Threat Armored Vehicles, and Establish Tank Firing Positions. Use of acronyms seems possible for Prepare/Operate FM Radio Sets, Determine Grid Coordinates, Recognize and Identify Friendly and Threat Armored Vehicles, and Establish Tank Firing Positions.

Provide rewards. The first opportunity for soldier response is followed by feedback. If the response is correct, then the feedback serves as a reward (positive reinforcement). The practice items will be ordered from simple (easier) to more complex (harder), which should maximize the likelihood of early positive rewards. Of course, the possibility exists for an incorrect response which will be followed by error feedback. However, this feedback provides guidance for arriving at the correct

response, and the soldier will have other attempts at correctly answering the same item.

The total number of items in a practice set, the ease of movement allowed within a lesson, and the help available to those having difficulty combine to provide the opportunity for slower learners to receive as many or more positive rewards for correct answers as the faster learners.

Provide knowledge of results. During the practice portion of the lesson the soldier will receive immediate feedback to each response via a MicroTICCIT page or overlay. A correct response elicits a congratulatory massage. An incorrect response receives, to the extent possible, guiding feedback, which is item-specific and based on error analysis. This feedback is intended to point out the probable error, explain the correct procedure, and give the correct answer. After the soldier completes the task test, he will get the test results: pass/fail; number of correct and incorrect responses; and an indication of the items that were incorrectly answered.

Provide practice. Both the total number and the scope of items in the practice set of each task will be comparable to that of the test for each task. This allows the soldier to practice to the level of performance stipulated in the standard of each task.

Overlearning cannot be guaranteed. The design of the instruction, examples, and practice should encourage the soldier to remain with a part through its entirety. However, the ease of movement that is provided within a lesson allows the soldier to select the test before practicing beyond simple mastery.

Specify learning guidelines specific to task categories. In addition to the general learning guidelines, which apply to all of the remedial tasks, TECEP provides guidelines that depend upon the category of the task

being trained. As Table 3 indicates, the remedial tasks represent several different task categories; however, it also can be noted that among the five tasks only three different guidelines are used. While the titles of the guidelines are the same, or similar, for the tasks, the application and interpretation is task-specific. These guidelines are presented in Tables 4 through 8, with titles in the left column and specific descriptions in the right column. The specific guidelines are incorporated into the training design for each task, as presented in Appendix A.

MicroTICCIT Authoring and Delivery

We will author the remedial training using ADAPT, the MicroTICCIT authoring language, on the MicroTICCIT system provided by the government. Walker, Kirchner, and Russo (1985) describe the system, authoring, and computer-management development in a companion report. ADAPT instruction has four levels: course, unit, lesson, and segment. The course is the largest body of content, and the segment is the smallest. A course can contain up to 30 units, and a unit can contain up to 30 lessons. A lesson can contain 30 segments, but ADAPT recommends no more than five. We will apply the results of the task analysis, cognitive task analysis, and TECEP analysis to sequence and block the part tasks, steps, and underlying map to process the sequencing of the instructional material. Training for the tasks will be designed at the lesson level with segments if necessary.

Course Structures. The overall course structure will incorporate the remedial CAI. Movement through the system at the course and unit levels is structured by an ADAPT map hierarchy which is activated by use of the MicroTICCIT keyboard. The instructor or classroom manager will use the keyboard to set up the system at the appropriate lesson or segment level for the soldier and will activate the videodisc player.

Table 4: Applications of TECEP Learning Guidelines Specific to "Prepare/Operate FM Radio Sets"

TECEP LEARNING GUIDELINES FOR RULE LEARNING AND USING		APPLICATION OF GUIDELINES FOR TRAINING SPECIFICATIONS
1.	Present and explain rule	video or graphical simulation with audio description of procedures for preparation, operation, and shutdown of equipment
2.	Recall and demonstrate concepts	audio explanation of the order of execution of steps; video or graphical demonstration of AN/VRC-64 display and method of response
3.	Present similarities and differences	differentiation of dials and switches; demonstration of possible sequences for completing procedures
4.	Predifferentiation of stimuli	determination of ability to carryout procedures assessed via practice exercise responses
5.	Manageable components	instructional grouping of steps for preparation, operation, and shutdown of equipment
6.	Relate to real job	photographs or realistic graphics of AN/VRC-64; hardcopy of CEOI provided; narrator in uniform; audio information that radio set is vehicular mounted
7.	Provide for practice	practice prior to testing that allows responses at choice points to indicate adjustment needed

Table 5: Application of TECEP Learning Guidelines Specific to "Determine Grid Coordinates"

TECEP LEARNING GUIDELINES FOR RULE LEARNING AND USING		APPLICATION OF GUIDELINES IN TRAINING SPECIFICATIONS
1.	Present and explain rule	live action demonstration of determing grid coordinates; audio explanation of lesson content
2.	Recall and demonstrate concepts	early presentation of examples and practice items; response analysis to determine understanding of components and concepts
3.	Present similarities and differences	only presentation of circumstances in which the rule as stated will be applied
4.	Predifferentiation of stimuli	response analysis to determine ability to differentiate grid coordinate and grid square, the grid square and within-grid square, coordinate, and coordinate on and off a line
5.	Manageable components	presentation in three segments - objective and instruction, training condition one, and training condition two
6.	Relate to real job	demonstration in field type situation with actor in uniform; use of standard military maps in instruction, examples, practice, and test; use of current armor forces procedure - coordinate determined by estimation; requirement to determine two-letter grid square identifier
7.	Provide for practice	practice prior to testing that allows both marking the point on the map corresponding to given coordinates and determining coordinates for a marked point on map

Table 6: Application of TECEP Learning Guidelines Specific to "Communicate Using Visual Signalling Techniques"

TECEP LEARNING GUIDELINES FOR RULE LEARNING AND USING; CLASSIFYING AND RECOGNIZING PATTERNS		APPLICATION OF GUIDELINES IN TRAINING SPECIFICATIONS
1.	Present and explain rule	live action demonstration of visual signals; signals paired with names (meanings)
2.	Recall and demonstrate concepts	audio information that there will be three methods presented for sending and receiving signals; demonstration of method of presentation of signals and methods of response
3.	Present similarities and differences	instructional grouping of signals by classification, method, and position; practice items will require responses from signals similar in form and/or meaning
4.	Predifferentation of stimuli	determination of ability to differentiate signals assessed via practice exercise responses
5.	Manageable components	instructional segments by categories - mounted and dismounted, with and without lights and flags, signals normally seen to signaller's back or front
6.	Relate to real job	presentation in field type situation; mounted or dismounted shown from that position; distances between viewer and signaller will approximate those in the field; actor in uniform
7.	Provide for practice	practice prior to testing that allows receiving signals and responding with meanings, and giving signals by selecting a demonstrated signal to match a command

Table 7: Application of TECEP Learning Guidelines Specific to "Recognize and Identify Friendly and Threat Armored Vehicles"

TECEP LEARNING GUIDELINES FOR CLASSIFYING AND RECOGNIZING PATTERNS; RECALLING BODIES OF KNOWLEDGE		APPLICATION OF GUIDELINES IN TRAINING SPECIFICATIONS
1.	Presentation and explanation	presentation of views of armored vehicles; highlighting of distinctive characteristics; presentation of correct nomenclature; identification as friendly or threat
2.	Timing	presentation in groups of five vehicles followed by examples and practice items for each group
3.	Present similarities and differences	presentation in five different views; grouped by recognition features; emphasis on unique features
4.	Predifferentiation of stimuli	determination of ability to recognize features assessed via practice exercise responses
5.	Manageable components	instructional grouping of five vehicles in six components; component selection based on current Army training program
6.	Relate to real job	use of scale model representations of real armored vehicles photographed on terrain board; audio narration emphasizes importance of quick recognition and identification of armored vehicles
7.	Provide for practice	practice prior to testing that allows for identification of a vehicle from two views, identification as friendly or threat, and choice of correct nomenclature

Table 8: **Application of TECEP Learning Guidelines Specific to "Establish Tank Firing Positions"**

TECEP LEARNING GUIDELINES FOR RULE LEARNING AND USING	APPLICATION OF GUIDELINES IN TRAINING SPECIFICATIONS
1. Present and explain rule	video or graphical simulation with audio description of procedures for establishing firing positions
2. Recall and demonstrate concepts	selection of graphic displays of tanks in specific defilade positions; responses to questions about those positions
3. Present similarities and differences	only presentation of circumstances in which rules stated will be applied
4. Manageable components	lesson is contained in one short presentation
5. Relate to real job	use of graphics to depict U.S. main battle tank; presentation of defilade positions to survival on the battlefield
6. Provide for practice	practice prior to testing that allows positioning of the tank in specified positions

Each of the five on-line tasks in the Diagnostic Test and Remedial Activities Unit will be a separate lesson; there may be several segments within each lesson that carry out the different objectives of the lesson. Initially, selection of segments within a lesson will be carried out using MicroTICCIT maps. However, since use of MicroTICCIT maps requires use of the keyboard by the student, we are replacing these maps with menus activated by the lightpen.

The diagnostic tests will be represented as a MicroTICCIT Test at the unit level. The test will have five sections; each section will be related to one of the remedial lessons. If a soldier does not meet the standards of a test section, the remedial training he is required to take will be indicated.

The first time that a soldier logs on to Unit One, he will be required to see an introduction which will include an overview of the MicroTICCIT learning station, instructions on the use of the lightpen, an explanation of the lesson structure and related terms, and an explanation of any appropriate authoring conventions. Authoring conventions include specifications for color uses, text layout, menus, movement terms and symbols and their standard positions, and graphics uses. For example, the color cyan will always indicate where the lightpen can be used.

Instructionl Components. The lessons and segments are designed using the MicroTICCIT author-specified structure of the CAI frames and will be labeled as follows (with related MicroTICCIT Rule-Example-Practice (REP) model labels in brackets):

A. **Objective** [Objective]

B. **Instruction** [Rule]

1. **Review** [Rule Hard]

2. **Help** [Rule Help or Rule Easy]

C. **Practice** [Example]

1. **Feedback**

2. **Help** [Example Help]

D. **Test** [Practice]

Objective presents, in text form, the learning goal of the lesson or segment. **Instruction** is the content of the lesson or segment. The basicpresentation is made via videodisc with audio, which can be augmented with second audio, text pages and overlays, and graphics. **Review** consists of a lesson or segment summary which can be a section of the videodisc instruction or text. **Help,** which in this case is a menu selection, provides additional explanatory instructional information in text form. **Practice** presents items (similar to the test items) for the soldier's response. These items are not scored, and an error analysis method provides guiding **Feedback** to incorrect responses. **Help,** in this case, is an available choice on a **Practice** page. The information is more specific to the item being practiced. **Test** is the scored presentation of items for the soldier's response. Within an instructional lesson or segment, movement will be made through lightpen selection on a menu. Soldier responses during **Practice** and **Test** will be made by lightpen.

Design of Diagnostic Tests

The tasks selected for MicroTICCIT testing and training need development of new tests that are administered on MicroTICCIT; thus, tasks were selected that are amenable to both CAI and computer-based testing (CBT).

Diagnostic testing of any of the prerequisite tasks can be accomplished on MicroTICCIT with some limitation. CBT has advantages over a paper-and-pencil medium; for example, CBT can display motion, control and

measure reaction time, and rapidly score and process responses. Through adaptive programming, testing may also be done more efficiently: Testing may proceed from the bottom of a hierarchical testing structure, testing items necessary for performance at each level, and cease or shift to a higher level depending upon student responses.

These features indicate the superiority of CBT over a paper-and-pencil medium. Both media, moreover, offer two advantages over hands-on tests: One is administrative economy, the other is the capability to measure a covert behavior (one that can not be seen). On the other hand, the state-of-the-art in simulation is such that psychomotor elements of task performance cannot be tested validly with other than a high fidelity response mode of the sort provided through hands-on testing. While many manual tasks do not entail skilled psychomotor response, performance of some cannot be measured adequately in other than a hands-on mode.

Implications for diagnostic testing of any of the tasks in the prerequisites are twofold. First, performance-oriented knowledge tests [sometimes called synthetic tests (Osborn, 1970) or symbolic-substitute tests (Shriver & Foley, 1974)] can be developed for all tasks. The important feature of synthetic tests is that, rather than asking questions about how to perform the task, the tasks simulate task stimulus conditions and elicit from the examinee a facsimile of the actual task response. Tests of this kind would be sufficient for the tasks picked for CAI development since none involve skilled motor responses.

Our proposed testing and training strategy begins with administration of the MicroTICCIT-based tests. If a student fails the test, then he has to have remedial instruction in the area of weakness diagnosed. Students who pass the test would be certified proficient and exempt from further training on the task.

The synthetic tests, however, require validation against hands-on tests before the synthetic tests are used in the evaluation. Therefore we have developed hands-on tests for each of the MicroTICCIT tasks selected (Appendix C). These hands-on tests require a review by SMEs (presumably BNCOC instructors) to insure doctrinal correctness and feasibility. Some of the tests may require a further tryout to insure feasibility and measure scorer reliability; however some of the tests have already been tried out in other projects.

Design of CAI Evaluation

Development of CAI for the remedial tasks involves four components: Task analysis and training design, diagnostic test design and development, trial implementation of tests and training, and production of CAI user guides and documentation. The results and products of each component must be assessed in terms of quality and effectiveness. Thus, a series of evaluation activities are planned for implementation throughout the CAI development cycle associated with the remedial tasks. The evaluation activities to be completed relative to each of the four components are discussed in the following sections.

Task Analysis and Training Design

Following analysis of the primary task-specific remedial training needs, functional specifications for prescriptions of the training design and content were identified for each of the remedial tasks selected for CAI development. These prescriptions identified the specific task objectives (i.e., conditions, action, and standard), the technical content to be addressed during instruction, testing objectives and standards, as well as training objectives, specifications and learning guidelines.

Detailed training prescriptions were prepared for each of the selected CAI tasks. Each training prescription has been reviewed by project staff for internal consistency and completeness. In addition, formal reviews of all training prescriptions will be completed by subject matter experts (SME) in order to validate the objectives, standards and quidelines associated with each remedial task. Each SME has been asked to provide written notations on copies of the training prescriptions which state the results of their reviews. The purpose of these written comments

is to document specific recommendations related to the assessment and revision of the training designs prior to development of training scripts.

If possible, at least two SME will review and comment on each of the training prescriptions. Based on the SME review comments, the appropriate modifications will be incorporated into the remedial task scripts. These instructional scripts will then be submitted to the COR for final approval.

Diagnostic Test Design And Development

Instruction related to each of the tasks selected for remedial CAI requires the development of new tests that are to be administered on MicroTICCIT. Performance-oriented knowledge tests (synthetic tests) have been designed for the CAI remedial tasks since each of these tasks do not involve the assessment of skilled motor responses.

The evaluation activities related to the design and development of the *diagnostic tests will focus on a formative assessment* of the synthetic tests to be presented via MicroTICCIT. This formative assessment will be accomplished by the comparison of test results from the synthetic tests with results obtained from related hands-on tests developed by project staff. This procedure will require that the hands-on tests be reviewed and refined by SME prior to their initial administration. Likewise, the synthetic tests to be incorporated into the remedial CAI must be reviewed by SME. The review of these tests by SME is necessary to confirm the content of each test.

The formative validation process requires that soldiers be tested in a controlled administration of the synthetic and hands-on tests. This sample should represent both novices and experts on the remedial tasks being tested. The formative validation process will be incorporated as part of the trial implementation of the CAI component. Administration of the

synthetic tests will produce a log of responses to each test item, as well as a total test score or result (pass/fail).

Responses to test items are gathered on a logging tape that must be turned on by the MicroTICCIT operator. The logging tape is a tape cartridge placed in the Data General magnetic tape drive during the periods when students are using MicroTICCIT courseware. The logging tape saves every key stroke made by every student while it is on (except in those courses or ADAPT chapters where the author has indicated that no logging should occur). The default setting in the Branch Specification Table for each ADAPT chapter is "Logging Tape On."

In order to use the logging data, the MicroTICCIT operator must transfer the data to a disk file in order to run the Item Analysis Report Utilities. The Command Line Interpreter (CLI) commands are LOG (start recording in the log file) and ENDLOG (stop recording in the log file). The Item Analysis Menu is accessible from the MicroTICCIT terminal while MicroTICCIT is running. Options include:

(1) Add log tape disk file records to data base;

(2) Add previously unqualified disk file records to data base;

(3) Print select Item Analysis data bases;

(4) Reset counts for selected items.

An Item Analysis report can be printed daily or at other intervals. New data can be added to the data base throughtout the course cycle. The data, however, require a large amount of disk space. The difficulties which may occur due to lack of disk space on the present 50 megabyte MicroTICCIT system are unknown; however, the disk file may be dumped to tape and loaded for processing at a later time. Exact procedures will be determined before the field trial of the computer-based course management (CM) system.

A MicroTICCIT Item Analysis report can be obtained for Test or Practice items. MicroTICCIT separates responses into two sub-sections according to whether the Test Segment from where the item was taken was passed or failed. For each item the following information is available:

Number of unanticipated responses: Any response not planned by the author is recorded. Responses for the 19K BNCOC courseware will ordinarily include only marking in undesignated areas since no keyboard entry is planned.

Number of misspellings: No misspellings should occur as the students will use a lightpen to mark areas on the display screen.

Results (correct/incorrect/unanticipated): The percentage of correct, incorrect and unanticipated responses is reported. The total of these three columns should be 100%.

Total number of responses: The total number of students responding to each item is reported.

Latency average: The average number of seconds required to respond to the item is reported. Time begins when the item is displayed on the screen.

Authored defined error type: MicroTICCIT will record the number of responses matching each type of error (Occasion Codes) defined by the author (up to 24 per item). Type of error could include the choices available to the students (e.g., multiple choice, a,b,c, or d) where the author records the number of times students choose the alternative response.

The test results, including item analyses, obtained from the validation sample allow comparisons to be made between soldier performance

on the synthetic test and the hands-on test. Overall, simple comparisons (e.g., gain scores) will be made between tests based on the proportion of soldiers passing or failing each test item and the overall test.

Trial Implementation of Testing and Training

Following SME review of the instructional content and performance-oriented knowledge tests (synthetic tests), development of the remedial CAI segments can be finalized. The CAI segments will be developed using the Adapt authoring language that permits presentation of the remedial instruction on MicroTICCIT. Final segments of the CAI will be implemented on a trial basis during one course cycle of 19K BNCOC.

The evaluation activities to be conducted relative to the trial implementation include a group interview of students who completed the CAI segments, a group interview with the 19K and 19E BNCOC instructors and course managers who conduct the CAI trial implementation, and a formative validation of the synthetic tests (discussed in detail in the previous section of this report). A preliminary validation of the remedial training will be conducted to identify needed revisions to the CAI. The preliminary validation procedure will analyze pre- and posttest measures obtained on soldiers who complete the MicroTICCIT remedial training as compared to their "controls" who require and receive direct remedial training. At the onset of the trial implementation, all entering students (19K and 19E BNCOC soldiers) will be pretested on the CAI remedial tasks using the MicroTICCIT diagnostic tests. Those students who fail the diagnostic test will be assigned to remedial training. Half of this group will be randomly assigned to complete the remedial training on MicroTICCIT and the remaining half will be provided with direct remedial training. Posttest measures, obtained via hands-on tests, will be recorded for all students who require

remedial training. In addition, posttest measures will be obtained via synthetic tests on MicroTICCIT for those soldiers completing the CAI remedial training. Thus, pre- and posttest comparisons can be undertaken for each of the five remedial CAI tasks as depicted in the figure below as well as comparison between the synthetic tests and hands-on tests accomplishing a formative validation of the synthetic test (as discussed in the previous section).

TASK	Diagnostic Pretest	CAI Posttest	Hands-on Posttest
Direct Training (Controls)	X		X
CAI Training	X	X	X

The number of students per cell is expected to be small and is the major reason why these evaluative comparisons are considered "formative" and "preliminary." These preliminary results are to be used as guidelines for the revision of the remedial CAI. A more standard evaluation will be undertaken by the ARI Field Unit at Fort Knox.

At the conclusion of the remedial instructional segment of the BNCOC course cycle used for the trial implementation, a one-half hour to one-hour time slot will be scheduled to allow the conduct of a group interview between the BNCOC student sample and the CAI developers. The purpose of this interview is to provide an opportunity to discuss student reactions to the CAI segments and to probe for responses related to the strengths and weaknesses of the instructional segments as well as identify areas

requiring modification. The group interview will contain a set of probes intended to gather information about individual perceptions related to the following items:

- Clarity of directions presented on MicroTICCIT
- Ease in using the lightpen
- Sufficient help provided by instructors/proctors when required
- Difficulty of CAI materials
- Time required to complete CAI materials
- Helpfulness of practice material
- Usefulness of example
- Overall rating of CAI instruction

The appropriate BNCOC instructors and course managers will be asked to participate in a one-half hour to one-hour group interview. During the group interview, the CAI developers will discuss and identify instructor reactions to the CAI segments and will solicit information about their perceptions about student reactions to the MicroTICCIT instruction and areas requiring improvement. Results of the group interviews will be synthesized by the CAI developers to identify modifications needed for the CAI segments.

Production Of User Guides And Documentation

Development of the CAI materials includes the design and production of user manuals and documentation of the instructional segments. The purpose of the user guides is to provide students, instructors, and course managers with an overview of the CAI segments and to instruct these same individuals on the use of MicroTICCIT for the remedial instruction being presented on the system. Documentation of the CAI segments is intended to provide a complete technical description of the remedial instruction that can be used in the future to modify the remedial segments.

User guide(s) will be produced and a training session for the BNCOC instructors will be scheduled and completed before the CAI trial implementation. At the conclusion of the remedial instruction segment of the BNCOC course cycle used for the trial implementation, instructors, and course managers will be interviewed to identify their assessments and perceptions of the user guides and documentation. These interviews are expected to be conducted in coordination with the group interviews cited above. The interviews will contain probes designed to gather information about the following items:

- Accuracy of the user guides and documentation
- Clarity of the information presented in the guides and documents
- Overall rating of the quality of the guides and documentation.

CAI developers will probe for judgements related to the effectiveness and overall quality of the user guides and documentation. Results from the interviews will be synthesized in order to identify needed modifications to guides and documentation before their final revision and submission to the COR.

Summary and Conclusions

Analysis of the 19K BNCOC diagnostic testing and remedial training requirements resulted in selection of five tasks for MicroTICCIT instructional authoring and delivery. The tasks are:

- Operate radio set.
- Determine grid coordinates of a point on a military map using the military grid reference system.
- Communicate using visual signalling techniques.
- Recognize and identify friendly and threat armored vehicles.
- Establish tank firing positions.

We applied standard task analysis and TECEP and produced training and testing designs for the selected tasks. Cognitive analysis provided detailed error analysis for the training designs.

The standardization of MicroTICCIT instruction, described in the section on MicroTICCIT authoring and delivery, has been coordinated with the development of other MicroTICCIT training for BNCOC (e.g., land navigation reported by Knerr, Sticha, Elder, Ramsberger, Harris, and Tkacz, 1984). This standardization insures that the training of these remedial tasks and the land navigation tasks will be consistent within the training and with the computer-managed instruction.

Validation of the diagnostic tests is planned for the BNCOC course cycle preceding the cycle for the trial implementation. The validated tests will be used to assess the training effectiveness during the trial implementation. Proposed support requirements (e.g., numbers of students for the test validation and trial implementation) are presented in the final section of the report.

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APPENDIX A

Task Analysis, Testing, and Training Design

TASK ANALYSIS, TESTING, AND TRAINING DESIGN

TASK: PREPARE/OPERATE FM RADIO SET (AN/VRC-64)

JOB TASK ANALYSIS

Task Objectives

Conditions: Given a functioning FM radio set (AN/VRC-64) for operation, a Communications-Electronics Operations Instruction (CEOI), and an operational radio net.

Action: Turn on the radio, determine and set the correct frequency, and enter a net.

Standard: Evaluator, on site, determines if the soldier performs the radio check using correct radio procedure within 5 minutes.

Task Number: 113-587-2043

Technical Content

1. Prepare radio for operation.

    a. Determine operating frequency from CEOI.

    b. Set band switch to required frequency range.

    c. Set frequency tuning controls to the authorized operating frequency.

    d. Set the squelch switch position per unit SOP.

    e. Turn radio on.

    f. Connect the CVC helmet to intercom control box.

    g. Check the connection of cables, and connection and mounting of the antenna.

    h. Set antenna frequency control.

        Warning: Do not permit manpack or vehicular antennas to come in contact with high-power lines or other sources of electricity; injury or death could result.

        Caution: If radio set is vehicular mounted, turn off the radio before starting or stoppping the vehicle engine; if possible, operate the radio set with engine running; and the engine speed should be high enough to indicate the battery is charging while radio is keyed.

2. Operate the radio

   a. Determine your own and distance station call sign from the CEOI.

   b. Listen on the operating frequency to make sure no other station is transmitting.

   c. Use push-to-talk switch of the audio accessory to key the radio for transmitting.

   d. Use correct radiotelephone procedure and authorized call signs to enter net. Use CEOI and correct procedures to authenticate.

   e. Use operator techniques to improve communications:

      (1) The antenna gives best results in the vertical position. Try repositioning your vehicle (diagonally or pointing towards the other stations).

      (2) With antenna tied down, try positioning your vehicle broadside to the other station.

      (3) If possible, avoid hills, powerlines, bridges, buildings, or forested areas.

      (4) In general, the higher up you are the better the odds for long-range and good communications.

3. Shut down procedure

   a. Turn the power switch to off position.
   b. Set the frequency tuning controls to either 30.00 or 53.00.

References

FM 21-3
TB SIG 291
TM 11-5820-398-12
TM 11-5820-401-10-1
TM 11-5820-498-12
TM 11-5820-667-12

DIAGNOSTIC TEST DESIGN

Test Conditions: Given a display of an AN/VRC-64 radio, an intercom control box C-2298/VRC, CVC with Y cord, a hardcopy (non-display) CEOI extract and a requirement to place the radio into operation.

Test Actions: Soldier must determine call signs and frequencies from CEOI and identify components and adjustments needed to place AN/VRC-64 into operation.

Test Standard: Soldier must correctly identify all components and procedures, and obtain correct information from the CEOI within 3 minutes.

Testing Strategy

1. Soldier will be given a hardcopy CEOI extract and identification of his unit and the unit he must contact.

2. Soldier must choose on the screen his call sign and the call sign and frequency of the unit he is contacting.

3. Soldier will be given a display of the AN/VRC-64. With the lightpen, he must identify the components he must adjust to place the radio into operation, that is:

   a. PWR switch
   b. ANT FREQ CONTROL
   c. BAND switch
   d. REC-TRANS FREQUENCY
   e. SQUELCH
   f. C-2298/VRC VOLUME control
   g. CVC connection

4. Soldier must enter net by selecting from display the correct transmission out of a choice of four.

5. Soldier will be given authentication challenge.

6. Soldier must select authentication reply out of CEOI extract and select from choices displayed.

7. Procedure must be completed within 3 minutes.

TRAINING DESIGN

Training Objectives

Training Conditions: Given a display of an AN/VRC-64 radio, an intercom control box C-2298/VRC, CVC with Y cord, a hardcopy (non-display) CEOI extract and a requirement to place the radio into operation.

Training Actions: Soldier must determine call signs and frequencies from CEOI and identify components and adjustments needed to place AN/VRC-64 into operation.

Training Standard: Soldier must correctly identify all components and procedures, and obtain correct information from the CEOI within 3 minutes.

Training Specifications

Prerequisites: None

Diagnostic Test: Soldiers will be tested on general knowledge about using FM Radio (AN/VRC-64) and given an opportunity to demonstrate knowledge of procedures. The diagnostic test will include an introduction and instructions to the soldier on how to take the test. This test is the same one as the end of lesson test for this task.

Sample Scenario: You have been issued a replacement radio for your vehicle which must be checked out.

Learning Guidelines: Rule Learning and Using

Present and Explain Rule

The instruction will be organized around a video or graphical simulation of the procedures for preparation, operation, and shutdown of the equipment. If video is used, photographs will be made of the AN/VRC-64 radio installed in an armor vehicle. There will be both still pictures of the dials and switches in every possible position, and movie sequences of a soldier's hand turning the dials and switches, connecting cables, etc. If a graphic is used to represent the AN/VRC-64, it will show the front of the radio with the amplifier-power supply group. Audio instructions will describe the actions of the procedures. For tasks involving the CEOI, a hardcopy abstract from the CEOI will be used.

Recall and Demonstrate Concepts

The audio explanation will inform the soldier of the steps that can be executed in random order and those which are prerequisite to others. The video or graphical simulation demonstration will indicate how the AN/VRC-64 will be displayed and will show the method of response for carrying out the procedures.

Present Similarities and Differences

The instruction will differentiate the various dials and switches which must be adjusted during the procedures. The examples presented during instruction will demonstrate several possible sequences for carrying out the procedures.

Predifferentiation of Stimuli

Determination of the soldier's ability to carry out the procedures for preparation, operation, and shutdown of the AN/VRC-64 will be assessed through the responses given to the practice exercises which contain similar items to the examples used in the instruction.

Manageable Components

The instruction will be structured into segments that group the steps used for preparation, operation, and shutdown of the equipment.

Relate to Real Job

The AN/VRC-64 will be pictured or realistically represented through graphics. Hardcopy of a CEOI extract will be provided for determining the operating frequency, the call signs, and authentication. The actor used to demonstrate the procedures will be in the uniform of a tank commander or crewman. Audio will be used to inform the soldier that the radio set is vehicular mounted.

Provide Help

Help will be readily available to the soldier in all parts of the instruction, examples, and practice. The soldier will be able to progress through the lesson in a manner of his own choosing. He has the option of seeing the instruction, a quick review of the procedures, or an example in the form of a guided demonstration of the procedures. During the practice exercises, help will be available that is linked to the specific step being viewed at the time.

Provide for Practice

The soldier will be able to practice the procedures involved in preparation, operation, and shutdown of the AN/VRC-64. The video will stop at choice points, and the soldier will be asked to indicate the switch or dial that is to be adjusted. He will use the lightpen to mark the screen and change the position of switches, dials, knobs, etc.

Overview

The soldier will be given the objective of the lesson, and then will have the options of seeing the instruction, a quick review of the procedures, an example in the form of a guided demonstration of the procedures, or the test. The instruction will be organized around a video or graphical simulation of the procedures for preparation, operation, and shutdown of the

equipment. This type of simulation would be most effective if user interactions were carried out through the use of a light pen.

The simulation could be carried out using either video or graphics. The main advantage of video is the increased realism of the simulation, which may increase its transfer potential. On the other hand, this simulation may require quite a bit of space on the videodisc, because the steps in the procedure may be carried out in many different orders. In addition, screen blanking during video searches may disrupt the instruction. If video is used, photographs will be made of the AN/VRC-64 radio installed in an armor vehicle. There will be both still pictures of the dials and switches in every possible position, and movie sequences of a soldier's hand turning the dials and switches connecting cables/accessories etc.

If graphics are used to represent the AN/VRC-64, the graphic will show the front of the radio with the amplifier-power supply group. The soldier, in demonstrating the use of the radio, will be able to mark the screen with the light pen to change positions of switches, knobs, dials, etc.

Description

The instruction will center around a video of the AN/VRC-64. Audio instructions will describe the actions of a soldier who is demonstrating the procedure. For tasks involving the CEOI, a hardcopy abstract from the CEOI will be used.

The practice will use the same video used in the instruction; there will be no audio, however. The video will stop at choice points, and the student will be asked to indicate the switch or dial that is to be adjusted. If the student makes an incorrect response at this point, the correct answer will be highlighted. When the student makes the correct response, the video will continue until the next choice point.

In the test, the student will not receive the prompts. In addition, the student will be allowed to perform the procedure in any acceptable order. Because of the large number of permissible orders, video stills or graphics will be used at this point, rather than the motion sequences used in the instruction.

TASK: DETERMINE THE GRID COORDINATES OF A POINT ON A MILITARY MAP USING THE MILITARY GRID REFERENCE SYSTEM

JOB TASK ANALYSIS

Task Objectives

1. **Determine the grid coordinates for a point marked on a map**

   Condition: Given a standard 1:50,000 military map with points marked, a grid coordinate scale, and a sharp pencil.

   Action: Determine the 6-digit coordinates for points marked.

   Standard: Locate 4 of 5 marked points within 100 meters, i.e., the 1st, 2nd, 4th, and 5th digits are exact; the 3rd and 6th digits are within 1, and specify the two-letter 100,000 meter grid square indentifier.

2. **Mark a point on a map from its grid coordinates**

   Condition: Given a standard 1:50,000 military map, a grid coordinate scale, a sharp pencil, and a 6-digit coordinate.

   Action: Mark the point on the map corresponding to the coordinate.

   Standard: Locate 4 of 5 points within 100 meters.

Task Number: 071-329-1002

REFERENCES FM 21-26
FM 21-2

DIAGNOSTIC TEST DESIGN

Test Conditions: Given a display of a 1:50,000 map and a requirement to read 6-digit coordinates and to plot locations given the coordinates.

Test Action: Determine coordinates and plot locations by estimation.

Test Standards: Determine 4 out of 5 6-digit coordinates to within 100 meters. Plot 4 out of 5 locations within 100 meters. Each problem must be completed within 30 seconds.

Testing Strategy

1. Display of a 1:50,000 map. Soldier must be able to call up marginal data (Grid reference box).

2. Soldier will be given an identifiable location (e.g., bench mark, road junction, manmade feature, or light point). Instructions will indicate he must estimate the 6-digit coordinate.

3. Superimposed on the map will be 4 to 6 choices of grid coordinates. Soldier will make his choice with the lightpen.

4. Soldier will be asked to identify 2-letter grid square identifier and must select from 2 to 4 choices. Grid reference box and map used must allow for possibility of 2 choices and preferably 4.

5. Soldier will be allowed 30 seconds to complete each problem.

6. Problem will be repeated with another point.

7. For the second part of the test, the soldier will be presented instructions that he must identify a point on the map given its 6-digit grid coordinate.

8. View of 1:50,000 map reproduction will be shown. Superimposed will be grid coordinates. Soldier must touch the lightpen to the map at the point he picks. Correct area will be sensitized to the equivalent of 100 meters.

9. Soldier will have 30 seconds to complete each problem.

TRAINING DESIGN

Training Objectives

1. **Mark a point on a map using a specified grid coordinate.**

   Training Condition: Given a representation of a portion of a standard 1:50,000 military map on a video screen with a 6-digit grid coordinate specified.

   Training Action: Point out on the map, by estimation, using the lightpen, the location indicated by a 6-digit coordinate.

   Training Standard: Correctly point to 4 out of 5 unmarked points within 100 meters. (30 seconds for each).

2. **Determine the grid coordinate for a point marked on a map, and specify the two-letter 100,000 meter grid square identifier.**

   Training Condition: Given a representation of a portion of a standard 1:50,000 military map on a video screen, with some locations marked.

   Training Action: Determine by estimation, the 6-digit coordinates for the marked points.

   Training Standard: Correctly identify 4 out of 5 marked points within 100 meters and specify the two-letter grid square identifier within 30 seconds for each point.

Training Specifications

Prerequisites: None

Diagnostic Test: Soldiers will be pretested on their ability to read 6-digit grid coordinates. This test will be administered the same way as the test given at the end of instruction for this task.

Sample Scenarios: Proceed from your present location to a point identified only by a grid coordinate. First mark your destination on your map.

Learning Guidelines: Rule Learning and Using

Present and Explain Rule

A live action demonstration will show a soldier determining grid coordinates using the grid reference system with a standard military map. There will be on-line explanations of what the lesson contains, what is available in each segment, and what is available to the soldier in the way of additional instruction and through help.

Recall and Demonstrate Concepts

Recall and demonstration of concepts will be handled through early presentations of example and practice items. Response analysis will analyze for understanding of the components and concepts of the rule and the resultant feedback will guide the soldier to understanding.

Present Similarities and Differences

In this task the rule always applies--there are no circumstances in which the specific rules for determining grid coordinates using the military grid reference system do not apply.

Predifferentiation of Stimuli

The reponse analysis will be used to determine that the soldier is able to differentiate between:

- grid coordinate and grid square,the part of the grid coordinate
- which is the grid square and which part is the within-grid square coordinate, and
- coordinates that lie on a line and those that lie off a line.

Manageable Components: Simple to Complex

The lesson will be presented in three segments. One segment will be for the lesson objective and the instruction. The other two segments will be for each of the two training conditions. Each of these two segments will have how-to instructions, examples, and practice items.

Relate to Real Job

The demonstration of how to determine grid squares will use an actor dressed in the uniform of a present-day tank commander. The demonstration will be carried out in a field type situation. Real map sections will be used in all the instruction, examples, practice exercises, and test. The procedure taught to determine grid coordinates will use the system presently used by armor forces--coordinates determined by estimation. Soldiers will be required to determine the two-letter 100,000 grid square identifier.

Provide Help

Help will be readily available to the soldier in all parts of the instruction, in examples and during practice. Help will be available in the form of a more detailed explanation of the method for determining grid coordinates if the soldier chooses to see it. Help keyed to the soldier's responses will be provided during examples and practice.

Provide for Practice

The soldier will have the opportunity to do example exercises and practice exercises in both marking the point on the map corresponding to given coordinates and determining the coordinates for a marked point on the map.

Overview

The lesson will be presented in three segments. One segment will contain the lesson objective and the instruction on how to determine grid coordinates. There will be a segment for each of the two training conditions. Each of these two segments will have an objective, instructions on using the system, practice items, and a test. The training conditions are (1) marking a point on a map by its 6-digit coordinate, and (2) specifying the 6-digit coordinate and the 2-letter 100,000 meter square identifier of a point marked on a map.

The soldier will use estimation to do the practice exercises and tests in this lesson. Coordinate scales will not be required.

Wrong answer feedback for identifying location:

If point chosen is close (area to be defined), a message will appear indicating such, and the soldier will be given a second chance. If missed on second try, move to next problem. In practice, soldier would be given the answer on the second miss and have help available.

If point chosen is inverted (read up, then right), a message will appear saying "read right, then up."

All other wrong answers will result in the soldier being told he is wrong, with a second chance given.
On tests items only the first answer counts.

Wrong answer feedback for inputting coordinates:

Same as above, with wrong answers appearing in red.

Description

The practice exercises and the test items will be presented using actual photographic sections of standard military maps on the color monitor. The photographic map sections will be recorded on a videodisc.

Segment 1 - This segment will contain the lesson objectives in text form. Following the objective the soldier will see a menu through which he can select to see the instruction on determining grid coordinates, see a review of how it is done, or return to the lesson map. The instruction will be live action video and graphics with voice over.

Segment 2 - Segments 2 & 3 will have the same general format. The first thing the soldier will see in each segment is the objective for the training condition. The objective will be presented by text. Next the soldier will see a menu. The menu will permit the soldier to see the instructions on how to perform the exercises and interact with the system, see a quick review of how to determine grid coordinates, to choose to do the practice items, or to take the graded test. He will also have the opportunity to return to the lesson map from which he can enter segment 1 to view the instruction.

The review will be an abbreviated version of the live action instruction.

In the practice the soldier will see a section of a map on the screen and be given a 6-digit grid coordinate. With the lightpen he will mark the point on the screen which he thinks represents the location of the grid coordinate. If correct, there will be a correct response feedback with an opportunity to go to the next practice item. If incorrect, there will be an appropriate feedback message and an opportunity to try again. A second wrong answer gets an error response, an indicator on the screen where he should have marked, an opportunity to get **Help** for that problem, and the box to mark to go to the next practice item. After going through 5 practice items, the soldier returns to the menu where he can choose to do more practice items or to do the scored test.

Test items are presented the same way as the practice items. The soldier will be given 5 problems. He must answer 4 out of 5 correctly with a time limit of 30 seconds for each. Feedback will be limited to a correct or an incorrect feedback message and an opportunity to go to the next problem. The soldier will be permitted to try the test a maximum of three times. Four correct answers out of 5 will get a congratulatory statement and a return to the lesson map. The segment square on the lesson map will turn green indicating completion of this segment.

Segment 3 - This segment will require the soldier to specify the 6-digit grid coordinate and the 2-letter 100,000 meter square identifier for a point marked on a map section presented on the color monitor. The 6-digit coordinate will be entered by the soldier using the lightpen and a number pad which will be displayed on the screen. After entering the grid coordinate, the soldier will enter the 2-letter identifier either by multiple choice or through use of the keyboard. Feedback and numbers of tries will follow the scheme developed for segment 2.

TASK: COMMUNICATE USING VISUAL SIGNALLING TECHNIQUES

JOB TASK ANALYSIS

Task Objectives

Conditions: In the field with flags (red, yellow, green), flashlight, and conditions amenable to movement using visual signals.

Action: Demonstrate procedure for each visual signal.

Standard: Evaluator on site determines if each visual signal is correctly demonstrated.

Task Number: 071-326-0608

Technical Content

Teaching Points

Visual signals are a means to communicate visually and can be used by all units. Visual signals are transmitted by:

Flags,
Lights,
Pyrotechnics
Panels
Arm-and-hand signals, and
Other prearranged methods.

Visual signals are suitable for sending prearranged messages rapidly over short distances, as well as for recognition and identification of friendly forces.

It is important to know all the visual signals used on the battlefield. It is more important to know those signals that can assist you in performing your job effectively if other means of communication are not available.

Signals for combat functions and battle drill may be used by both mounted or dismounted troops.

Visual signals give the soldier a means of communication with other persons in the unit. They should be practiced until their use becomes second nature. Visual signals must be given correctly and distinctly.

When a movement or action is to be executed by less than the total unit, the signaler will point, if necessary, toward the person(s) or element(s) of a unit as a warning that a signal will follow.

When a movement or action is to be executed by the entire unit, the proper signal should be preceded by the signal "ATTENTION".

Most signals may be given from the ground or from a vehicle.

References

FM 7-7 (HTF), The Mechanized Infantry Platoon and Squad
FM 17-95 (HTF), Cavalry
FM 21-60-, Visual Signals
STP 17-19K1-SM (Soldier's Manual), M1 Armor Crewman

DIAGNOSTIC TEST DESIGN

Test conditions: Given a display of hand and arm signals, flashlight signals and flag signals, and a requirement to name the signal or to choose the correct signal for a named action.

Test Action: Soldier must select name of signal or select named signal.

Test Standard: Soldier must correctly identify 18 of 20 signals. Soldier will have 10 seconds to name signals and 20 seconds to identify correct signal when given action desired.

Testing Strategy

1. A block of 44-75 hand and arm, flashlight and flag signals will be developed. Signals will show motion and be as viewed from position and location (tank or ground) that they would normally be viewed from. Viewing distances will also be realistically duplicated (i.e., close in for ground guide signals, up to 100 meters for flag signals). Each signal segment will be approximately 7 seconds long.

2. Testing will be in two parts. In the first part, the soldier will be shown a visual signal. Superimposed will be four choices of what that signal is. (These choices will include of commonly selected wrong answers.) Soldier will have 10 seocnds to select his choice using the light pen.

3. Procedure will be repeated with 9 other signals. Soldier must correctly identify 9 out of 10.

4. In the second part of the test, soldier will be given the name of a signal. He will then be presented with consecutive displays of four signals. He will step through up to 4 signals and indicate which is the correct signal in 20 seconds.

5. Procedures will be repeated with 9 other signals. Soldiers must correctly identify 9 out of 10.

TRAINING DESIGN

Training Objectives

Training Conditions: Live action shots of visual signals being given by soldier on a color monitor.

Training Action: (1) Identify the presented visual signals by multiple choice responses and (2) find the visual signal which matches a given command.

Training Standard: Soldier must correctly identify 18 of 20 signals. Soldier will have 10 seconds to name signals and 20 seconds to identify correct signal when given action desired.

Training Specifications

Prerequisite: None

Diagnostic Test: Soldiers will be pretested on their ability to recognize and name visual signals. This test will be administered in the same way as the test given at the end of instruction for this task.

Sample Scenario: You are TC of the lead tank and you must move to a new location using radio silence.

Learning Guidelines: Rule Learning & Using; Classifying and Recognizing Patterns

Present and Explain Rule

The visual signals will be presented by live action demonstrations. During instruction, the signals will be paired with the name (meaning) of the signal. There will be helpful hints and explanations to help the soldier remember the signal and to give the signal meaning. A review phase will also be available that will match the demonstrated signal to its name only.

Recall and Demonstrate Concepts

The live action demonstration will inform the soldier that he will see three methods for sending and receiving signals (flags, flashlight, and arm and hand). The demonstration will show how the signals will be seen and how the soldier will respond.

Present Similarities and Differences

During practice, the soldier will be required to choose from answers and from demonstrated signals which are similar in form and/or meaning. The instruction will group signals by classification, method, and by position.

Predifferentiation of Stimuli

Determination of the soldier's ability to tell the difference between signals which are similar in nature will be accomplished through the responses given to the example and practice exercises which contain similar items.

Manageable Components

The instruction will be presented in segments covering manageable portions of the total number of signals to be learned. They will be divided by categories--mounted and dismounted, with and without lights and flags, signals normally seen looking to the signaler's back or front.

Relate to Real Job

The signals will be viewed as they would be in actual use in a field situation. Those normally given from a mounted or dismounted position will be shown from that position. The distances from the viewer (camera position) to the signaler will approximate the distances normally existing in a field situation. The actor used to demonstrate the signals will be in the uniform of a tank commander or crewman.

Provide Help

Help will be readily available to the soldier in all parts of the instruction, in examples, and during practice. The soldier will be able to progress through the lesson in a manner of his own choosing. He can choose to receive a quick review of each signal, see the full instruction on any chosen set of signals, and during examples and practice, help will be available tied to the specific signal being viewed at the time.

Provide Practice

The soldier will be able to practice receiving the signals and demonstrating knowledge of what they mean. He will also practice, after a fashion, giving signals by seleting a demonstrated signal to match a command. These two things, receiving and giving signals, in a simulated field situation, is very close to the real job.

Overview

Instruction will be on how to communicate using 3 kinds of signalling techniques (flags, lights, and arm-and-hand signals). The objective will be presented by text on the monitor. Next, the basic instruction will be presented. This will include a live action introduction with an explanation of why visual signals are important, and coverage of the teaching points. A demonstration of each signal, by type or category, will be available to the soldier along with an explanation and helpful hints for remembering each.

There will be example items with help available. The scored practice (test) will present animated signals and/or live action demonstration of signals and the soldier will both identify the viewed demonstration and, given a command, select the matching signal.

There are approximately 44 visual signals to be presented. Some are common/obvious and easily associated with their utility. Others, such as color and position of flag, will require some memory work.

Description

The visual signals will be presented by live action demonstrations on videodisc. Daylight signals will be photographed in a field environment. Signals usually given from the TC hatch will be filmed that way. Flashlight signals will all be presented as viewed from the position of the recipient.

Following a live action introduction the soldier will see a menu. From the menu the soldier can choose to see the instruction, review the signals, perform some practice or take the test.

The instruction will consist of short live action demonstrations of each signal with text for explanations and/or learning and memory hints. The soldier will use the lightpen to proceed to the next item.

The review will be the same short demonstration of each signal with audio identifying the signal. The soldier can quickly step through the signals for a quick review.

Practice will be on test-like items.

The test will be formatted two ways. (1) The soldier will see the live action demonstration of a signal and respond by multiple choice. (2) The soldier will be required to step through up to six signal demonstrations and designate which one matches a given maneuver command.

TASK: RECOGNIZE AND IDENTIFY FRIENDLY AND THREAT ARMORED VEHICLES

JOB TASK ANALYSIS

Task Objectives

Conditions: In a garrison or field environment in which armored vehicles, in tactical or simulated tactical settings, are visible.

Action:

(a) Recognize and identify vehicles as friendly or threat, and
(b) recognize and identify vehicles by vehicle nomenclature.

Standards:

(a) Recognize 10 of 12 armored vehicles as friendly or threat; and
(b) identify 9 of 12 armored vehicles by vehicle nomenclature.

Task Number: 878-920-1001

Technical Content

The basic visual Combat Vehicle Identification (CVI) program depicts multiple views of 30 friendly and threat armored vehicles that every soldier should be able to identify as friendly or threat.

The soldier will see pictures of 10 armored vehicles for 10 seconds each.

During the 10-second viewing, the soldier indicates if vehicle is friendly or threat, and identifies vehicle by vehicle nomenclature using those features unique to the vehicle from among the following recognition features:

Recognition Features

Armament

- Main gun
- Coaxial machine gun
- Machine gun

Number of road wheels and/or support rollers
Spacing of road wheels and support rollers
Belly wheels
Turret shape/placement (dome, round pear shaped/ rear, center, forward)
Shape of engine deck (flat, sloped, large, small)
Searchlight, searchlight position
Nose shape (blunt/square)
Side shape (square/sloping)
Mounting of machine guns (forward/sides)
Location of gun mount
Type of gun tube
Bore evacuator placement
Muzzle break (single/double/slotted)
Radar dish
Hull shape
Splash guards
Skirting over tracks or wheels
Sprocket placement
Exhaust louvers
Commander's machine gun (carried pointing forward/rearward)
Other identifying features (e.g., V-shaped splash guard on the T-64; boat shaped prow, PT-76; no bore evacuator; distinctive storage boxes; no turret, e.g., Swedish MBT)

References

GTA 17-2-9 (Combat Vehicle Identification Program)
GTA 17-2-8
FM 17-95

DIAGNOSTIC TEST DESIGN

Test Conditions: Given a display of an oblique or front view of an armored vehicle which duplicates a view seen through binoculars at 1000 meters.

Test Action: Identify vehicles as friendly or threat and identify vehicles by nomenclature.

Test Standard: Within 10 seconds per presentation, soldier must identify 10 of 12 presentations as friend or threat and 9 of 12 by nomenclature.

Testing Strategy

1. Still views of model vehicles in natural background will be used. Two views (oblique left and front) of each of 30 vehicles will be available (oblique and frontal). Display will be adapted from ARI CVI training kit.

2. Each vehicle will be displayed with a superimposed "Friend/Threat" choice on the left and a listing of nomenclature of four vehicles on the right. Soldier must first select Friend or Threat and then must make choice of nomenclature. Choices must be made by touching a box on the screen with the light pen. Nomenclature choices will include vehicles commonly confused with the correct choice.

3. Each display will last 10 seconds. Choices must be made during this 10-second period.

4. Eight different vehicles will be presented for each test. Four of the vehicles will be presented twice (2 different views). Each retest will involve a different mix of vehicles and/or views.

TRAINING DESIGN

Training Objectives

Training Conditions: Given a display of an oblique or front view of an armored vehicle which duplicates a view seen through binoculars at 1000 meters.

Training Action:

(a) Recognize and identify vehicles as friendly or threat.
(b) Recognize and identify vehicles by vehicle nomenclature.

Training Standard:

(a) Recognize 10 Of 12 armored vehicles as friendly or threat; and
(b) identify 9 of 12 armored vehicles by vehicle nomenclature.

Training Specifications

Prerequisites: None

Diagnostic Test: Soldiers will be prestested on their ability to recognize and identify friendly and threat armored vehicles. This test will be administered the same way as the test given at the end of *instruction for this task.*

Sample Scenario: You are in a tactical situation and you are the tank commander. Your tank is in a turret-down position. You observe two armored vehicles, both of different configurations, moving around a natural terrain feature on a course which would bring them into a direct confrontation. It's time for action. You must very quickly recognize and identify these vehicles as friendly or threat.

Learning Guidelines: Classifying and Recalling Bodies of Knowledge

Presentation and Explanation

The soldier will be presented with views of armored vehicles. Distinctive characteristics will be highlighted. The correct nomenclature and indication whether the vehicle is friendly or threat will be given for the corresponding vehicle.

Timing

Views of armored vehicles will be presented in groups of five, followed by example and practice items for the group. Another group of five will be presented next, and so on, until all 30 vehicles are seen by the soldier.

Present Similarities and Differences

Armored vehicles will be presented in 5 different views and grouped according to recognition features which are distinct. Unique recognition features will be highlighted with graphic arrows. Dissimilar features will not be emphasized, since this would serve to confuse the soldier.

Predifferentiation of Stimuli

The soldier's ability to tell the difference between similar recognition features will be determined by responses given in the practice exercises and lesson test.

Manageable Components

The instruction will be presented in six components (five vehicles presented in each component) for a total of 30 vehicles to be presented in the instruction. The vehicles chosen for each component are based on the current training program in use by the Army. For example, a composite of vehicles from different countries are included in each component with a mix of main battle tank, armored personnel carrier, light tank, amphibious tank, etc.

Relate to Real Job

Armored vehicles will be viewed by the soldier on a color video monitor. A voice-over narration will set the scene, and emphasize the importance of being able to quickly recognize and identify armored vehicles. The vehicles will be viewed in a simulated field condition. This will be done with scale-model representations of real tanks photographed on a terrain board. The scale models will be painted in camouflage as in a real battle situation.

Provide Help

The soldier who has difficulty in identifying armored vehicles by similar or distinct recognition features will have a review of the models available. The review will provide the soldier wih a picture of the vehicle (the scale model representation) along with the correct nomenclature and whether it is friendly or threat.

Provide Practice

The soldier will be able to practice identifying vehicles. He will be shown two views of a vehicle, with the chance to indicate whether it is friendly or threat, and choose its correct nomenclature from a list of 4 choices. He will be given feedback on his responses, and a chance to retry a second time if he makes a wrong response.

Provide Rest

Instruction for armored vehicles will be provided in groups of 5. The soldier will be presented with instruction for identifying a total of 30 armored vehicles. After each group of 5, the soldier will have examples and practice items available. There will be an opportunity for rest (breaks) before he proceeds to the next block of instruction.

Overview

This task will involve learning to recall bodies of information, e.g., equipment nomenclature, and classifying items that appear different by identifying common features.

The instruction will be a color video presentation of pictures of armored vehicles with accompanying recognition features and nomenclature. The soldier will use the lightpen to progress through the instruction.

Description

The instruction will consist of scale model pictures of 30 armored threat and friendly vehicles presented on a color video display with a list of recognition features and the appropriate nomenclature.

Five different views of each vehicle will be used during instruction. The five views will be left side, right side, oblique left, oblique right and front. Recognition features, including armament, will be displayed using graphic arrows and labels to highlight significant recognition features. (Voice-over video may possibly be used here).

The soldier will have available a quick review of the models. The review will show a vehicle, with correct nomenclature, and whether it is friendly or threat.

The practice items will be presented in the same manner as the test, except that during the practice the soldier will get feedback as to whether he is right or wrong, and he will be given a chance to retry. If he is wrong the second time, he will be given the correct answer.

The test will be a display of the same scale models that the soldier saw in the instruction. The soldier will see a scale model representation of 12 armored threat and friendly vehicles for 10 seconds each. He will be told that during the 10 seconds he must indicate whether the vehicle is friendly or threat and identify the vehicle by its correct nomenclature. The soldier must correctly identify 10 out of 12 armored vehicles as friendly or threat, and 9 of 12 must be identified by their correct nomenclature. The test will take this format: The soldier will see the scale model representation of a friendly or threat armored vehicle. He will respond to a "fire" or "no fire" choice with the lightpen. He will indicate the vehicle's correct nomenclature by a multiple-choice response using the lightpen.

Once in the test, the soldier must complete it; he cannot quit at this point.

The soldier will have 3 opportunities to take the test. If he doesn't meet the standard the first time through, he may choose to go through the instruction again or see the quick review before attempting another try at the test.

TASK: ESTABLISH TANK FIRING POSITIONS

JOB TASK ANALYSIS

Task Objectives

Conditions: A tank with a crew in a field situation and a general location of a firing position identified by the tank commander.

Action: Move to and occupy a tank firing position in the general location pointed to by the tank commander.

Standards: Evaluator on site determines GO, NO-GO:

(1) Firing position is in the general location pointed out.
(2) Tank is level as possible.
(3) Tank is in hull-down position.
(4) Gunner has clear field of fire.

Task Number: 171-123-1008

Technical Content

1. The tank commander points out the general location for the firing position.

2. The tank crew moves tank to that location and establishes a hull-down firing position.

   a. Tank is positioned as level as conditions permit.

      (1) The tank commander or gunner talks the driver into position.
      (2) The loader opens breech and looks along the bottom of the main gun tube.

   b. The tank is positioned so the gunner, looking through the telescope, can observe the field of fire and the loader's vision is not masked by any obstacles.

   c. Stop the tank when the gunner and loader have an unhindered view of the field of fire and prepare a range/sketch card.

      (1) The range/sketch card is drawn by the tank commander or gunner. A range card is made for the M48A5 and M60 series tanks. The sketch card is made for the M1 by the M1 gunner.

      (2) The loader places reference stakes at the front and rear edges of the track where the track leaves the ground.

d. The tank is backed into a turret-down or hide position.

The turret-down position conceals most of the tank but allows the tank commander observation.

The hide position completely covers the tank from direct fire and conceals it from ground observation. In this position, a loader might be selected by the platoon leader to man an observation post (OP) for the platoon, to observe the area, and to alert the crew to enemy approach.

2. When in the turret-down or hide position the crew will:

a. Camouflage the tank and its position.

b. Perform during-operation checks and services on the tank using the operator's manual.

3. Move to and occupy alternate and supplementary firing positions using procedures outlined above.

a. Use covered and concealed routes to move from one position to another.

b. Back out of firing position when changing positions to minimize exposure to enemy observation. When moving, all crew members must watch for threat air and ground targets.

4. Reoccupy a firing position.

Reference

FM 17-12
FM 71-1
STP17-19K1-5M

DIAGNOSTIC TEST DESIGN

This design illustrates how part of the testing will be designed and conducted.

Test Conditions: Given a display of a tank and defilade terrain and a requirement to assume various defilade positions.

Test Action: Soldier must position tank in relation to the defilade according to the position directed.

Test Standard: Positions selected must match positions directed, provide maximum defilade for the position, and provide the observation or fields of fire required in the position.

Testing Strategy

1. Display will provide a presentation of an M1 tank and various defilade positions. Display should allow soldier to select view of tank and defilade from cross sectional, facing defilade and facing tank locations.

2. Tank will be moveable with lightpen.

3. Soldier will indicate "set" or final position by touching box when he is satisfied with position.

4. At "set" selection, tank position will be "read" as correct or incorrect.

5. Soldier will be directed to select turret down, hull down and hide positions.

6. Display will allow variations on the terrain/defilade to be used for retests.

TRAINING DESIGN

Training Conditions: Using videodisc representations of scenes and drawings, graphics and multiple-choice and other questions which can be answered through use of the light pen.

Training Action: Demonstrate knowledge of the procedures involved by proper responses to the interactive instructional program using the light pen.

Training Standard: (to be determined)

Training Specifications

Prerequisites: None

Diagnostic test: Soldiers will be tested on knowledge and procedures involved in establishing firing positions. This test will be administered the same way as the test given at the end of instruction for this task.

Sample Scenario: You as tank commander have been instructed to establish tank firing positions at a specified grid coordinate. It is your job to see that the crew properly establishes a firing position and alternate positions.

Learning Guidelines: Rule Learning and Using

Present and Explain Rule

The content of the rule will be presented in the objective and explanation will be presented in the first part of the instruction.

Recall and Demonstrate Concepts

The soldier will demonstrate the understanding of the components of the rule by selecting graphic displays showing the tanks in specific defilade positions and by answering questions about those positions.

Present Similarities and Differences

The rule as it applies to this lesson will be as stated. There will be no circumstances where it will not be applied.

Manageable Components

This lesson is short enough that it will be manageable for the soldier in one part.

Relate to Real Job

This will be a part task lesson. The real job task involves a crew activity under the direction of the Tank Commander. The extent of relating the intstruction to the real job will be related to use of graphics that depict the US main battle tank and relating the defilade positions to survival on the battlefield.

Provide Help

Help will be available to the soldier in the form of review of the instruction and specific guiding help for any missed items during examples or practice.

Provide for Practice

The soldier will have a chance to practice in positioning the tank in the specified positions.

Overview

The soldier will be presented with the objective and the instruction so he will know what the task is and how to respond. The soldier will then be given the choice to do the scored practice or to receive instructions in:

Positioning the tank (hull-down).
Positioning the tank (turret-down or hide position).
Activities in turret-down position.
Moving to alternate and supplementary firing positions.
Reoccupying a firing position.

These may be accessed through a menu for instruction and questions in each area.

The soldier can do the scored practice (test) at a time of his choice. The graded practice will consist of interactive reponses to test for knowledge of procedures and general knowledge concerning establishment of tank firing positions.

Description

The instruction will involve techniques such as:

1. Selecting the tank which is in hull-down or turret-down position from front views, side views, etc. (See Diagnostic Test Design)

2. Letting soldier pan a scene as a loader and as a gunner to determine clear field of fire.

3. Using lightpen to indicate placement of stakes to mark tank position.

APPENDIX B

Cognitive Task Analysis:

Methods and Results

COGNITIVE TASK ANALYSIS: METHOD AND RESULTS

Method

Subjects

Subjects were 14 armor crewmen from the 2/6 Cavalry Squadron of the Center/School Brigade at Fort Knox. Soldiers were either E-4 or E-5 in grade and had not previously attended BNCOC. Records indicate that the 2/6 sends more soldiers to 19K BNCOC at Fort Knox than any other single unit in the Army (Morrison, Drucker, & O'Brien, 1985). Thus, the subjects were representative of entrants in 19K BNCOC.

Tasks

The following tasks were chosen for remedial training on MicroTICCIT:

1. Recognize and Identify Friendly and Threat Armored Vehicles
2. Communicate Using Visual Signalling Techniques
3. Determine Grid Coordinates
4. Establish Tank Firing Positions
5. Prepare/Operate FM Radio Sets

The time available for performance testing was limited, and considerable analysis had been performed on the last (radio) task (Morrison & Goldberg, 1982; Morrison, 1982; Morrison, 1984). Hence, subjects were tested on only the first four tasks.

Materials and Procedure

Recognize and Identify Friendly and Threat Armored Vehicles. Stimulus materials were taken from the Combat Vehicle Identification Training Cards developed by the Army Research Institute Field Unit at Fort Hood. These materials consisted of 30 photographs of armor vehicles shown on one side of a playing card and the correct nomenclature and critical features of the vehicles printed on the reverse side of the card. The cards showed several views of scale models on a terrain board. To simplify presentation, only the oblique views were used in the present analysis. All models were shown with a camouflage paint scheme and no national markings. The task of identifying the vehicles was devided into two subtasks. For the first subtask, soldiers were instructed to sort the cards into two piles corresponding to friend and threat (referred to as IDENTIFY VEHICLES AS FRIEND OR THREAT). For the second subtask, soldiers placed each picture on top of a corresponding index card. There were 30 such index cards with the nomenclature and nationality of vehicles printed on them (IDENTIFY VEHICLES BY NOMENCLATURE).

Communicate Using Visual Signalling Techniques. Stimulus materials for this task were taken from the Soldiers Manual for Armor Crewman (FM 17-19K1). Illustrations of each of the 43 visual signals were photocopied and mounted on 3 x 5 index cards. A second set of 43 index cards listed the definitions or meanings of each of the signals. In accordance with the Soldiers Manual, the 43 signals were divided into three groups: (a) 22 signals used to control vehicles under daylight conditions, (b) 5 signals used to control vehicles under night conditions using a flashlight, and (c) 16 tactical signals. For each of the three types of signals, soldiers were required to place the illustration on top of the corresponding definition.

Determine Grid Coordinates. Soldiers were supplied with a standard 1:50,000 scale military map of the Fort Knox area and a coordinate scale. Soldiers were scored separately on two subtasks. For the first subtask (DETERMINE COORDINATES), soldiers were shown a particular point on the map and told to determine its six-digit coordinate including the two-letter 100,000 meter square identification. For the second subtask (IDENTIFY FEATURES), soldiers were given a coordinate and asked to identify in writing the associated map feature. Three exercises for each subtask were determined for a total of six items per test. Two alternate forms of the test were developed.

Establish Tank Firing Positions. The Soldiers Manual for M1 Armor Crewman (FM 17-19K1) describes this task as a series of four subtasks: (a) occupy a primary firing position using hull-down technique, (b) occupy a primary firing position using turret-down technique, (c) occupy alternate and supplementary firing positions, and (d) reoccupy a firing position. Presented in this fashion, this task appeared to be procedural in nature. As such, the recall analysis techniques described by Morrison (1984) could be used to determine the organization of task steps. However, upon questioning subject matter experts, it was discovered that the steps were not executed as a linear procedure. Rather, parts of the task are executed as demanded by the situation. For instance, the hull-down technique is used primarily for engaging targets and the turret-down is used for observing and acquiring targets. One or the other is used (not both) depending upon the tactical situation. In that sense, the task appears to be a collection of conceptual rules. Two types of performance tests were developed to fit both conceptions of the task. In accordance with the method for analyzing procedural tasks outlined by Morrison (1984), the first task required the soldier to recall all of the steps of the task in as much detail as possible. A tape recorder was used to record responses. The second test consisted of a paper-and-pencil test of conceptual knowledges derived from the Soldiers Manual description of the task.

Design

Soldiers were tested on each task twice.[1] This design feature was incorporated in the analysis for two reasons. First, considering the

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[1]The exception was one soldier who was unable to complete a second trial on the visual signal task because of time limitations.

relatively small sample of soldiers, two performance trials provided a larger data base from which to estimate performance on each task and subtask. Second, a comparison of performance across the two trials provided an indication of the relative ease of learning.

Each soldier received a different random order of tasks for the first trial. The same random order was reported for the second trial in order to maintain approximately equal time intervals between repetitions of the tasks. At the end of the first trial for each task, soldiers were allowed to compare their answers with the correct ones; however, they were not given any systematic instruction on any of the tasks.

Results

Vehicle Recognition

Table B-1 presents the mean number of errors for each of the two subtasks (IDENTIFY AS FRIEND OR THREAT and IDENTIFY BY NOMENCLATURE) across the two test trials. As can be seen, the soldiers failed to show significant improvement in performance on either subtask over the two trials.

Table B-1

Mean Number of Errors for the Two Subtasks

Subtask	Trial 1	Trial 2	t[a]	p
IDENTIFY AS FRIEND OR THREAT	4.4	3.4	1.687	>.10
IDENTIFY BY NOMENCLATURE	12.7	11.9	0.859	>.10

[a]T-test of differences between correlated means.

In Table B-2, the error data are broken down according to vehicle and collapsed over trials to yield an overall estimate of the probability of error on both subtasks. The results indicated that, in general, the soldiers were more accurate at identifying the vehicles as friend or threat than they were at identifying the vehicles by nomenclature. However, the relationship between performances on the two subtasks was not consistent across vehicles. For instance, the BMD (a Soviet armored personnel carrier) was correctly identified as "threat" in 93% of the attempts; however, it was correctly identified by nomenclature in only 29% of the cases. In contrast, the AMX-30 (a French main battle tank) was correctly identified as "friend" in only 50% of the cases; however, it was correctly identified by nomenclature in about 36% of the attempts. To measure the relationship between performance on the two subtasks, the probabilities of error were correlated across all the vehicles. The correlation was relatively low ($r = .30$) indicating that the identification of a vehicle as friend vs. threat was not a good predictor of identification by nomenclature and vice versa.

Table B-2

Probability of Error on Both Subtasks for Each Vehicle

Vehicle	Subtask: Identify as Friend or Threat	Subtask: Identify by Nomenclature
T54/55	.107	.357
T62	.036	.357
T72	.214	.429
BMD	.071	.714
BMP-1	.143	.679
BRDM-2	.179	.571
BTR-50	.036	.643
BTR-60P	.071	.689
ZSU 23-4	.036	.071
ZSU 57-2	.179	.357
SP-74	.143	.536
PT-76	.107	.357
ASU-85	.000	.214
CENTURION	.036	.536
CHIEFTAIN	.036	.607
SCIMITAR	.071	.714
SCORPION	.107	.607
SALADIN	.286	.607
LEOPARD	.036	.321
JAGDPANZER	.179	.286
MARDER	.071	.429
ROLAND	.250	.464
GEPARD	.214	.571
AMX-13	.286	.536
AMX-30	.500	.643
M48	.143	.000
M60A1	.000	.000
M1	.036	.036
M113	.036	.000
M109	.179	.036

The inconsistency of performance on the two subtasks can be partially explained by examining the psychological similarity of the vehicles. This was done by first constructing a confusion matrix displaying the frequency that each picture was paired with each nomenclature and vice versa. The matrix was approximately symmetrical. For instance, the picture of the T72 is paired with the T62 nomenclature the same number of times that the T62 picture is paired with the T72 nomenclature. Both types of errors were used to calculate a single probability of confusion between each pair of vehicles. This probability (multiplied by 1000) was taken as a measure of psychological proximity. These proximities were then subjected to a cluster analysis using the average linkage solution. Results from the analysis are displayed in Figure B-1 in the form of a hierarchial structure or dendrogram. A simplification of those results is presented below in Table B-3. The clusters were identified by drawing circles around appropriate vehicles and then the clusters were organized into friendly and threat according to how the soldiers tended to classify the cluster as a whole.

Table B-3

Results from Cluster Analysis of Vehicle Recognition

Tended To Be Identified As		Not
Friend	Threat	Clustered
MARDER AMX-13 SALADIN ROLAND SCIMITAR SCORPION ZSU 57-2 GEPARD LEOPARD CENTURION CHIEFTAIN	BMD BMP-1 BTR-60P BRDM-2 BTR-50 PT-76 SP-74 ASU-85 T55/54 T62 T72 AMX-30	JAGDPANZER ZSU 23-4 M1 M109 M48 M60A1 M113

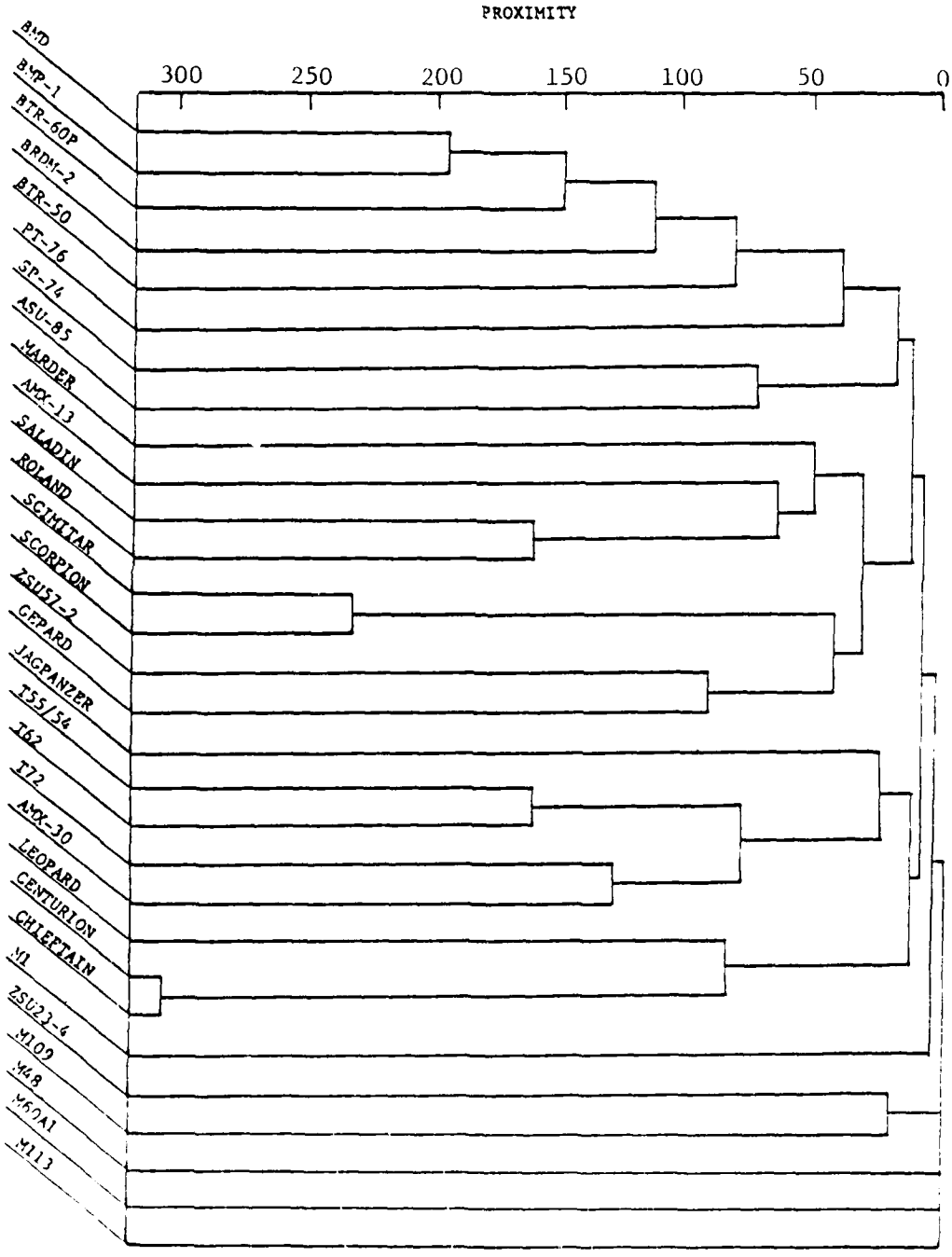

Figure B-1. Dendrogram From Cluster Analysis of Vehicle Recognition Data.

The following are some generalities that may be drawn from this analysis:

1. The lowest level clusters revealed a tendency of the soldiers to confuse specific pairs of vehicles within a single country or within the larger category of friend or threat. Examples include two British main battle tanks (Centurion and Chieftain) and two Soviet tanks (T55-54 and T62). The confusions can be explained in terms of similarity in appearance as well as similarity in nomenclature. A notable exception is confusion across countries of the T72 (a Soviet tank) and the AMX-30 (a French tank) despite the lack of similarity in nomenclature. The rather high visual similarity of the AMX-30 to tne T72 and other Soviet tanks is the evident cause of the tendency of soldiers to incorrectly identify the former vehicle as "threat."

2. The large cluster of Soviet vehicles (BMD, BMP-1, BTR-60P, BDRM-2, BTR-50, PT-76) indicate that these smaller multipurpose armored vehicles were often confused with one another. Except for the last vehicles, the nomenclatures all started with "B" presumably increasing their psychological similarity. Despite their tendency to be confused for one another, these vehicles were nevertheless reliably recognized as being "threat."

3. The vehicles that did not cluster were those that were reliably identified by the soldiers. This category included all of the US vehicles, with which the soldiers should have been well familiar. The other two vehicles were visually distinctive non-US vehicles: (a) the Jagdpanzer (West German), a squat, turretless, tracked vehicle with a very large gun; and (b) the ZSU 23-4 (Soviet), a tracked weapon systems with an exceptionally large turret and four antiaircraft guns.

4. With the exception of the AMX-30 and the ZSU 57-2, the clusters consisted of either friend or threat vehicles. Thus, one would expect confusions within but not between friend and threat categories. This fact is consistent with the low error rates for the first subtask (IDENTIFY VEHICLES BY NOMENCLATURE).

Visual Signals

Table B-4 presents the mean number of errors for each of the three types of visual signals.[2] In contrast to vehicle recognition, soldiers significantly improved in performance over the two trials for the day signals and for the tactical signals.

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[2]These data do not include the Trial 1 data for the soldier who did not complete Trial 2 of the test.

Improvement in performance on the night signals may have been obscured by a ceiling effect; i.e., the soldiers performed nearly perfectly on Trial 1.

Table B-4

Mean Number of Errors in Identifying Three Types of Signals

Type of Signal	Trial 1	Trial 2	t[a]	p
Day Signals	2.46	0.62	3.57	<.01
Night Signals	0.77	0.32	1.10	>.10
Tactical Signals	9.08	5.77	3.82	<.01

aT-test of differences between correlated means.

More detailed analyses of performance on the three types of signals are presented below.

Day signals. The error data were collapsed across the two trials and the probability of error for recognizing each individual signal was calculated. As can be seen in Table B-5, with few exceptions, the error rates were relatively low.

Table B-5

Probability of Error for Each Day Signal

Signal	Probability of Error
A. START ENGINES/PREPARE TO MOVE	.074
B. STOP ENGINES	.000
C. MOUNT	.259
D. DISMOUNT/TAKE A PRONE POSITION	.259
E. MOVE FORWARD/COME FORWARD	.000
F. NEUTRAL STEER	.000
G. MOVE IN REVERSE	.000
H. CHANGE DIRECTION	.148
I. BUTTON UP/UNBUTTON	.000
J. CLOSE UP DISTANCE AND STOP	.000
K. STOP (TRACKED VEHICLES)	.000
L. RAISE RAMP	.111
M. LIGHTS OFF	.000
N. LIGHTS ON	.000
O. LOWER RAMP	.111
P. LEFT TURN/COLUMN LEFT	.037
Q. PASS AND KEEP GOING	.037
R. RIGHT TURN/COLUMN RIGHT	.074
S. ATTENTION	.074
T. I AM READY/ARE YOU READY?	.185
U. DISREGARD COMMAND/AS YOU WERE	.148
V. I DO NOT UNDERSTAND	.074

Figure B-2 and Table B-6 present the cluster analysis results for the signals used under daylight conditions. Because of the low rate of confusions, the cluster analysis indicated only a few meaningful clusters. For the items that were confused, the clusters appear to be based on the visual similarity of signals. The first cluster of signals (illustrations C, D, E, and F) involve similar movements of a single extended arm. The two signals in the second cluster (H and V) both require the soldier to hold both arms close to the body. The last cluster of signals requires extention of both arms out from the body, either over the head (S and U) or straight out from the body (T).

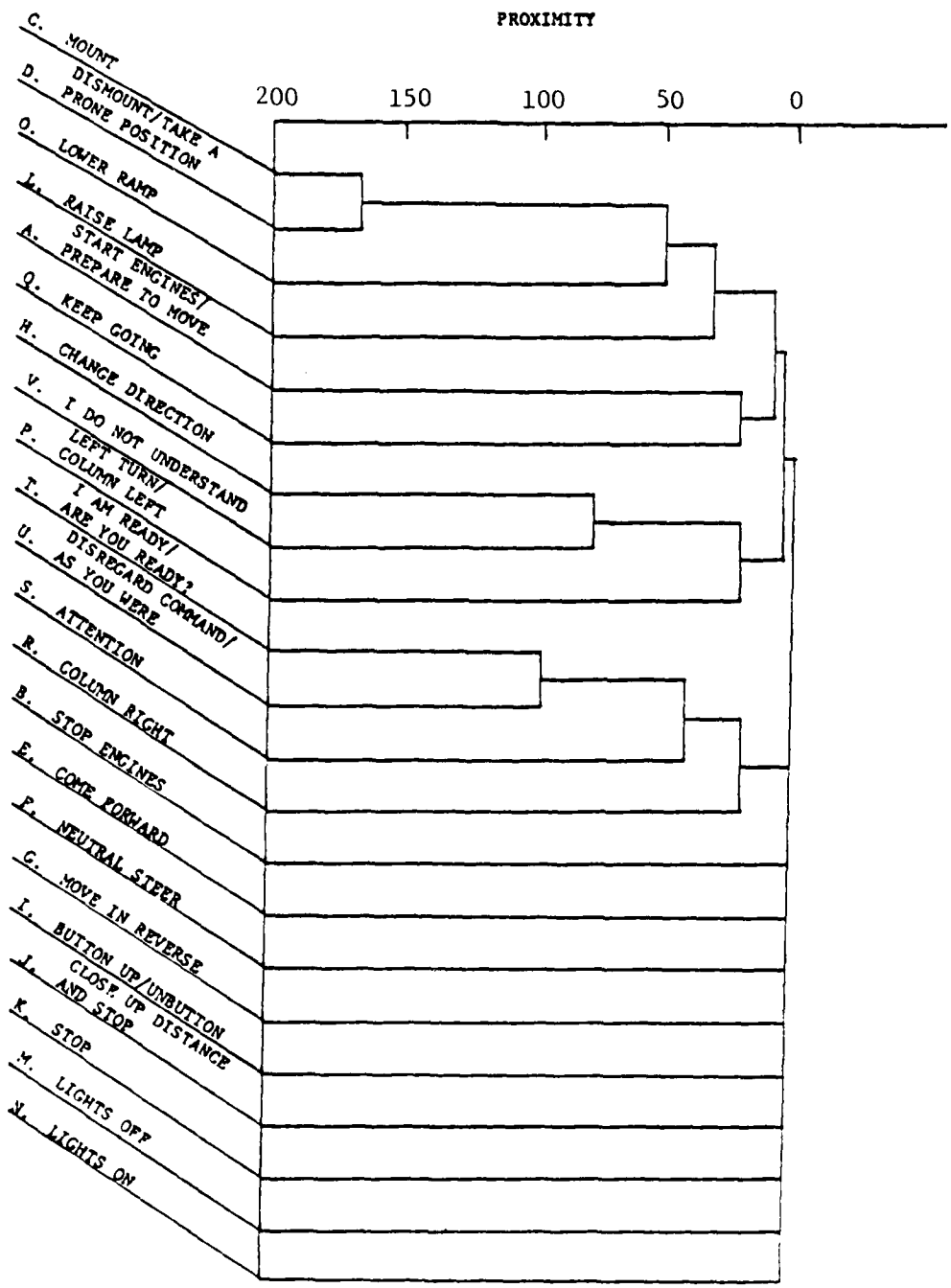


Figure B-2. Dendrogram From Cluster Analysis of Day Signal Data.

Table B-6

Results from Cluster Analysis on Day Signals

Clustered	Not Clustered
C. MOUNT D. DISMOUNT/TAKE A PRONE POSITION	A. START ENGINES/PREPARE TO MOVE
E. LOWER RAMP F. RAISE RAMP	B. STOP ENGINES
H. CHANGE DIRECTION V. I DO NOT UNDERSTAND	E. COME FORWARD
T. I AM READY/ARE YOU READY? U. DISREGARD PREVIOUS COMMAND/ AS YOU WERE	F. NEUTRAL STEER
S. ATTENTION	G. MOVE IN REVERSE
	I. BUTTON UP/UNBUTTON
	J. CLOSE UP DISTANCE AND STOP
	K. STOP
	M. LIGHTS OFF
	N. LIGHTS ON
	Q. KEEP GOING
	P. LEFT TURN/COLUMN LEFT
	R. RIGHT TURN/COLUMN RIGHT

Night signals. The error data for each night signal over both trials are shown in Table B-7. As in the previous set of signals, the error rate was relatively low.

Table B-7

Probability of Error for Each Night Signal

Signal	Probability
A. START ENGINES	.074
B. STOP/STOP ENGINES	.185
C. GO/FORWARD/MOVE OUT/INCREASE SPEED/ DOUBLE TIME	.148
D. MOVE IN REVERSE/SLOW DOWN	.185
E. TURN LEFT (RIGHT)	.037

As can be seen in Figure B-3 and Table B-8, the analysis of confusions indicated only two clusters of signals. Again, the clusters can be interpreted as confusions on the basis of visual similarity. The first cluster (C, B, and D) is comprised of signals involving straightline movements either horizontally (B) or vertically (C), or, in the case of D, a stationary blinking flashlight. In contrast, the second cluster consists of signals using more curved and sweeping movements: a figure "8" for A and a circular movement for E.

Table B-8

Results from Cluster Analysis of Night Signals

C. GO/FORWARD/MOVE OUT/ INCREASE SPEED/DOUBLE TIME D. MOVE IN REVERSE/ SLOW DOWN B. STOP/STOP ENGINES	A. START ENGINES E. TURN LEFT (RIGHT)

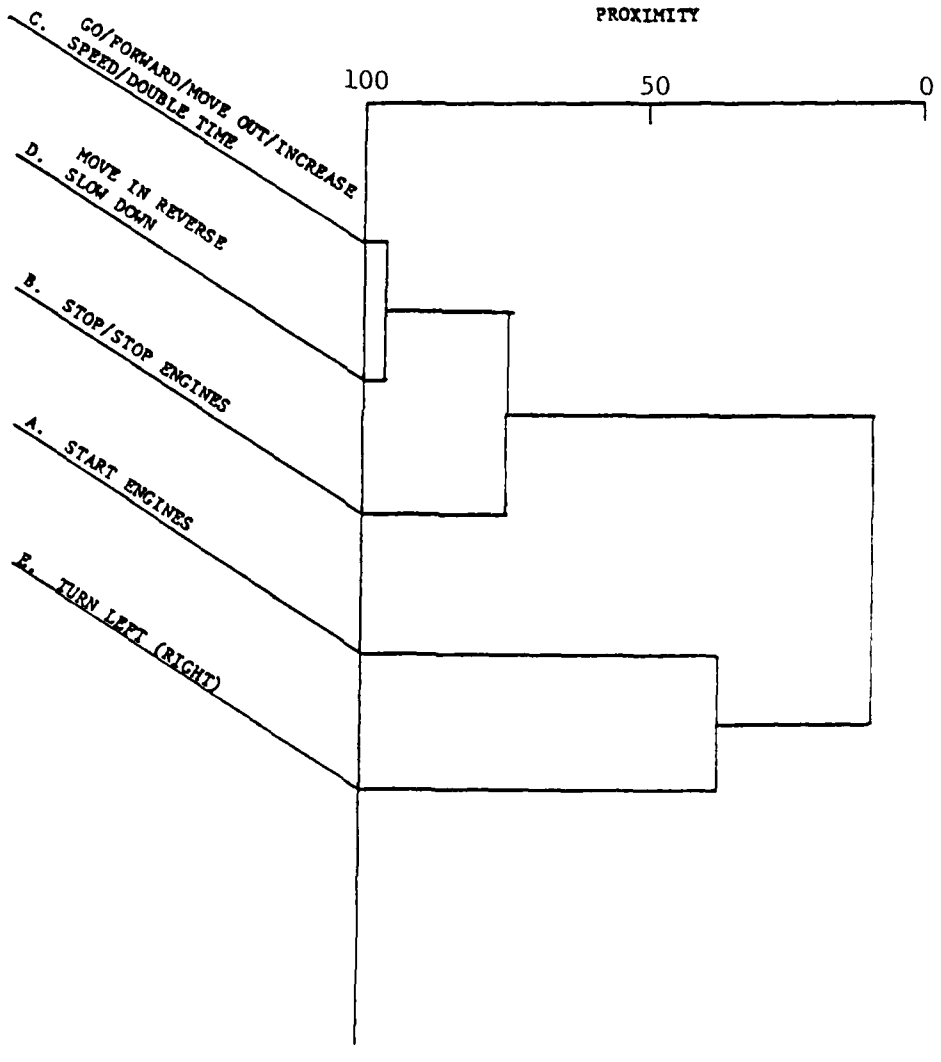


Figure B-3. Dendrogram from Cluster Analysis of Night Signal Data.

Tactical signals. The error data for each tactical signal over both trials is shown in Figure B-4 and Table B-9. In contrast to the previous two sets of visual signals, the error rate was relatively high.

Table B-9

Probability of Error for Each Tactical Signal

Signal	Probability
A. TRAVELING	.556
B. TRAVELING OVERWATCH	.444
C. CEASE FIRING	.667
D. DISMOUNT	.148
E. MOVE UP ON MY LEFT	.111
F. MOVE UP ON MY RIGHT	.222
G. COVER OUR MOVE	.444
H. ENEMY IN SIGHT	.444
I. COMMENCE FIRING	.815
J. DANGER/ENEMY IN SIGHT	.593
K. MOVE OUT	.630
L. NBC HAZARD PRESENT	.074
M. MOUNT	.630
N. DISMOUNT	.593
O. DISMOUNT AND ASSAULT	.519
P. ASSEMBLY AND CLOSE	.630

Because of the high rate of confusions, the cluster analysis revealed a more complex structure of clusters. Table B-10 shows two large clusters of six signals each. The second cluster contains signals that relate to movements of the tank, whereas the first relates to more static behaviors. Lower level clusters indicate again that soldiers tended to confuse those signals that are similar in appearance and/or definition. Examples are signals B and G which are both shown as similar arm signals delivered on the tank, and signals K and M which both involve waving a single green flag. In contrast, the specific confusion between Signals H (ENEMY IN SIGHT) and J (DANGER/ENEMY IN SIGHT) appears to be due to similarity in meaning rather than appearance: The former is executed by holding a rifle over the head, whereas the latter is executed by waving a red flag over the head.

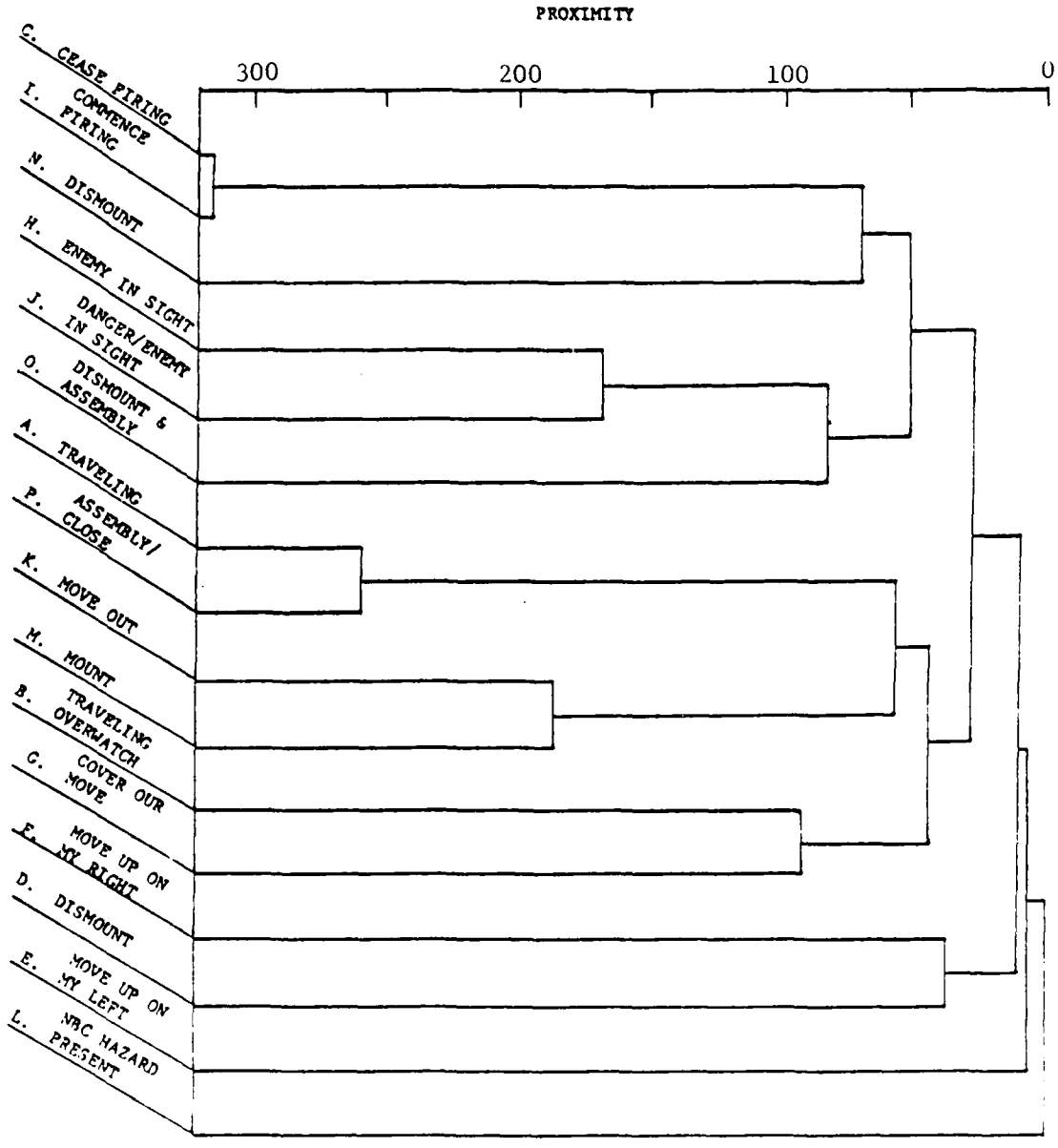


Figure B-4. Dendrogram From Cluster Analysis of Tactical Signal Data.

Table B-10

Results from Cluster Analysis of Tactical Signals

Clustered	Not Clustered
C. CEASE FIRING I. COMMENCE FIRING	E. MOVE UP ON MY LEFT
N. DISMOUNT (FLAG)	F. MOVE UP ON MY RIGHT
H. ENEMY IN SIGHT J. DANGER/ENEMY IN SIGHT	D. DISMOUNT (HAND)
O. DISMOUNT AND ASSAULT	L. NBC HAZARD PRESENT
A. TRAVELING P. ASSEMBLY/CLOSE	
K. MOVEOUT M. MOUNT	
B. TRAVELING OVERWATCH G. COVER OUR MOVE	

Determine Grid Coordinates

Observation of soldier behavior during testing indicated that soldiers used a variety of different procedures for determining grid coordinates. For instance, some soldiers determined the correct east-west coordinate from the top of the map and came down the appropriate number of grid squares; others went from the bottom up. Nevertheless, as can be seen in Table B-11, analysis of their recorded responses showed an average of less than one error (one of six possible) on either subtask and no differences across trials.

Table B-11

Mean Number of Errors for the Two Subtasks

Task	Trial 1	Trial 2	ta	p
DETERMINE COORDINATES	0.429	0.214	0.898	>.10
IDENTIFY FEATURES	0.357	0.571	0.822	>.10

Over all soldiers, there were only 9 errors committed on the first subtask and only 13 on the second. Table B-12 provides a breakdown of the types of errors committed on both subtasks. Seven of the 21 total errors involved reversing the six-digit grid coordinates. That is, soldiers either recorded or read the first three digits as the north-south dimension and the second three digits as east-west, the opposite of the correct procedure.

Other errors in determining coordinates (the first subtask) included recording incorrect second or forth digits of the six-digit coordinate. This error was probably committed while scanning across the map to locate the horizontal or vertical coordinates. In all four of these instances, the soldiers recorded the coordinates for an immediately adjacent grid square. The other type of error on this subtask was in recording the incorrect two-letter 100,000 meter square identifier. This error may have been magnified by the use of a special map (Fort Knox) which shows areas from four different 100,000 meter squares.

In addition to reversing coordinates, one of the other errors committed while identifying features was to identify a nonspecific feature (e.g., "road"), which might be in any grid square as well as the one in question. Another error might be classified as a "near miss" because soldiers identified another feature within the targeted grid square. And, finally, in one case, a soldier misinterpreted the symbol for the correct feature (a radio tower) as that for a similar symbol in the map legend (a base site).

Table B-12

Breakdown of Errors on the Two Subtasks

Subtasks Types of Errors	Frequency
DETERMINE COORDINATES	
Incorrect Second or Fourth Digit	4
Incorrect Two-Letter Identification	3
Reversal of Coordinates	2
Total	9
IDENTIFY FEATURES	
Reversal of Coordinates	5
Nonspecific Feature	4
Other Features Within Grid Square	3
Misinterpreted Symbol	1
Total	13

Establish Tank Firing Positions

When asked to recall the task, soldiers provided very little information. This finding is consistent with the notion that soldiers do not remember this task as a standard procedure. It was reasoned that performance on the paper-and-pencil test provided a better representation of what soldiers know about the task. Analysis of performance on the test indicated an average of 3.7 errors on the first trial (or 69% correct on the 12-item test) and 1.6 errors (86% correct) on the second. A t-test of difference between dependent means indicated that the improvement across trials was significant, t (13) = 5.196, $p < .01$.

Table B-13 presents an item-by-item breakdown of the results collapsed across the two trials. The first two questions required the soldier to identify firing positions from illustrations taken from field manuals. Performance on these two items indicated that soldiers did not have problems visually identifying firing positions.

Table B-13

Breakdown of Errors on the Knowledge Test

Items	Probability of Error
1. Visually identify primary, alternate, and supplementary positions.	.179
2. Visually identify turret-down/hide and hull-down position.	.000
3. Position for observing and acquiring threat targets.	.571
4. Position for direct-fire main gun engagements.	.143
5. Position for preparing a range card or sketch range card.	.143
6. Position which allows most of the tank to be concealed but allows the TC to observe targets.	.321
7. Position which completely covers the tank and conceals it from ground observation.	.179
8. Position in which crew should perform during-operations checks and services.	.000
9. Position which requires a dismounted observer.	.071
10. Position wherein the tank is camouflaged.	.286
11. Where stakes should mark tank's position.	.286
12. Who should guide tank back into position.	.500

Items 3-10 relate to the functions of each of the firing positions. The poor performance on items 3 and 6 may be related to difficulty in the semantic interpretation of the items. On item 3, soldiers were asked to identify which position (turret-down, hull-down, or hide) is used primarily for observing and acquiring threat targets. In addition to the correct

alternative (turret-down), soldiers often chose the hull-down alternative as well arguing that both positions can be used to observe and acquire targets. Whereas this response was correct in a sense, the phrase "primarily for observing" was meant to contrast turret-down with hull-down, which is used primarily for engaging targets. On item 6, soldiers were asked to identify which position (same alternatives) conceals most of the tank, but allows the tank commander to observe targets. The most common error was to choose hull-down as well as the correct alternative, which was turret-down. The controversy on this item appears to be on the definition of "most"; some soldiers argued that concealment of the hull is indeed most of the tank.

On item 10, soldiers were asked to identify in which position the tank should be camouflaged: hull-down, turret-down, or hide. The relatively poor performance on the task seems to be due to a conflict between the task as presented in the Soldiers Manual and the experience of soldiers. According to FM 17-19K1, the answer is either the turret-down or the hide position. The most frequent error was for soldiers to also include the hull-down position with the others. Soldiers argued that the tank should be camouflaged in all positions, and a staff subject matter expert agreed with that assertion.

Items 11 and 12 relate to some facts concerning the reoccupation of a firing position. Soldiers who made an error on item 11 (location of stakes) provided no explanation for their response. This finding seems to indicate a simple lack of knowledge for this item. In contrast, the soldier was supposed to indicate for item 12 which of the crew members is responsible for guiding the tank back into a firing position. The correct answer is "loader." However, soldiers expressed their skepticism in letting the lowest ranking and least experienced crew member having that responsibility.

APPENDIX C

Hands-on Tests for MicroTICCIT Tasks

OPERATE RADIO SET

Equipment Required To Set Up Station And Conduct Test

AN/VRC-64 mounted in M1 tank
1 CVC with Y cord
Stopwatch

Procedures To Be Performed Before Testing Each Soldier

1. Disconnect the CVC.
2. Turn PWR switch to OFF.
3. Turn RT function switch to OFF.
4. Place the frequency 66.20 on the REC-TRANS Frequency.
5. Set the Band switch to 30-52.
6. Set the ANT FREQ CONTROL to 30-35.
7. Set the volume control to the full counterclockwise position.

Procedures To Conduct And Score Test

1. To score PM 8, score the soldier GO as long as he makes any adjustments on the Volume.

Scorer: _____ Soldier: _____

Date: _____ SSAN: _____

SCORESHEET

OPERATE RADIO SET

INSTRUCTIONS TO SOLDIER: During this test you must place the radio into operation. You must operate off the face of the radio, not thru the intercom. The frequency you are to use is 56.30.

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
Operate AN/VRC-64			
1. Turned PWR switch to ON.	____	____	_____
2. Turned RT function switch to SQUELCH.	____	____	_____
3. Set the Band switch to 53-75.	____	____	_____
4. Set the ANT FREQ CONTROL TO 56-60.	____	____	_____
5. Set the MC Knob to 56.	____	____	_____
6. Set the KC knob to 30.	____	____	_____
7. Connected CVC to audio with the longer cord connected to the left hand plug.	____	____	_____
8. Turned volume knob to the halfway point.	____	____	_____

Time to place radio into operation _____.

Scorer: _____ Soldier: _____

Date: _____ SSAN: _____

SCORESHEET

DETERMINE GRID COORDINATES
OF A POINT ON A MILITARY MAP
USING THE MILITARY GRID REFERENCE SYSTEM

INSTRUCTIONS TO SOLDIER: For this test you must read two sets of grid coordinates. First you must read the six digit coordinates to Hays Cemetery. Your answer must be in six digits and must include the hundred thousand grid square identifier. You will have one minute. Begin.

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
1. Used 1:50,000 scale on coordinate scale.	____	____	_____
2. Read right first, then up (0194).	____	____	_____
3. Read six digits.	____	____	_____
4. Read location correct to within 100 meters.	____	____	_____
5. Read the correct grid square identifier (FS).	____	____	_____
6. Read coordinates within 1 minute.	____	____	_____

Soldier's coordinates: _____

Time to read six digit coordinates. Seconds: _____

INSTRUCTIONS TO SOLDIER: You now must read the six digit coordinates to The Floating Bridge Site. Your answer must be in six digits and must include the hundred thousand grid square identifier. You will have one minute. Begin.

7. Used 1:50,000 scale on coordinate scale.	____	____	_____
8. Read right first, then up (0000).	____	____	_____
9. Read six digits.	____	____	_____
10. Read location correct to within 100 meters.	____	____	_____

DETERMINE GRID COORDINATES
OF A POINT ON A MILITARY MAP
USING THE MILITARY GRID REFERENCE SYSTEM

Equipment Required To Set Up Station And Conduct Test

Map Sheet, Vine Grove overprint Sheet 38591V Edition T-DMATC, 1:50,000
(one per soldier tested)
Coordinate scale, GTA 5-2-10 or plotting scale
Pencils
Field table or desk
Chair or stool
Magic marker or felt tip pen
Stopwatch

Procedures To Be Performed Before Testing Each Soldier

1. Lay out the map sheet, coordinate scale and sharpened pencils on the field table or desk.

2. Circle the grid squares that contain the first two problem points with the felt tip marker.

Procedures To Conduct And Score Test

1. Instruct the soldier to write his name on the map sheet.

2. Insure the soldier has identified the correct point for the correct problem. Repeat the instructions at any time if requested.

3. Have the soldier announce the grid coordinates or, if more than one soldier is tested at a time, write them down on the map sheet.

4. Observe the soldier to score PM 1 and 7.

5. Score PM 2 and 8 when the soldier announces or writes down the coordinates by noting the sequence of the coordinates.

6. The correct coordinates for the first six digit problem are 017945. Readings from 016 to 018 and 944 to 946 are acceptable.

7. The correct coordinates for the second six digit problem are 001004. Readings from 000 to 002, and 003 to 005 are acceptable.

8. the score PM 14 and PM 17, measure the soldier's mark with the coordinate scale.

9. To score a GO on PM 14 the soldier's plot must read between 989 and 991 and between 919 and 921.

10. To score a GO on PM 17 the soldier's plot must read between 963 and 965 and between 016 and 018.

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
11. Read the correct grid square identifier (FT).	____	____	_____
12. Read coordinates within 1 minute.	____	____	_____

Soldier's coordinates: _____

Time to read six digit coordinates. Seconds: _____

INSTRUCTIONS TO SOLDIER: You must now plot the coordinates that I give you by marking the point on the map with the pencil. You may write them down on the edge of the map The coordinates you are to plot are ES 990920. You will have one minute. Begin.

13. Used 1:50,000 scale on the coordinate scale.	____	____	_____
14. Plotted location to within 100 meters.	____	____	_____
15. Plotted location within 1 minute.	____	____	_____

Location plotted by soldier: _____

Time to plot coordinates: _____

INSTRUCTIONS TO SOLDIER: You must now plot these coordinates. Again you may write them down. The location is ET964017. You will have one minute. Begin

16. Used 1:50,000 scale on the coordinate scale.	____	____	_____
17. Plotted located within 100 meters.	____	____	_____
18. Plotted location within 1 minute.	____	____	_____

Location plotted soldier: _____

Time to plot coordinates: _____

USE VISUAL SIGNALS TO CONTROL MOVEMENT (MOUNTED)

Equipment Required To Set Up Station And Conduct Test

Flashlight
Signal flags set (red, yellow, green)
Extract from Soldiers' Manual (Task No. 071-326-0608) or FM 21-60
Assistant scorer

Procedures To Set Up Test Site

1. The assistant scorer will be giving the 17 signals in the second part of the test. Rehearse him until he can give the signals accurately and quickly. Provide him a sequence list of the signals from the scoresheet and the SM or FM extract to use as reference during the test.

Procedures To Conduct And Score Test

1. To administer PM 1 through 13, position the soldier facing you and 10-15 feet away. Announce each signal to the soldier. Allow him approximately 10 seconds to complete the signal, then score him accordingly by referring to the pictures by the PM.

2. To administer PM 14 through 28, direct the soldier's attention to the assistant scorer. Position the assistant scorer 30-35 feet away. The assistant scorer should give the signals as if he were mounted in the turret, that is, with his back to the soldier.

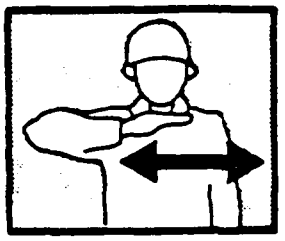
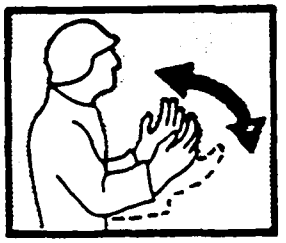
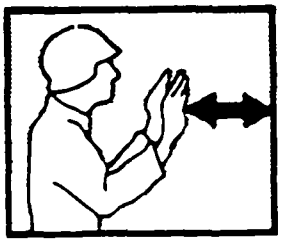
Scorer: _____ Soldier: _____

Date: _____ SSAN: _____

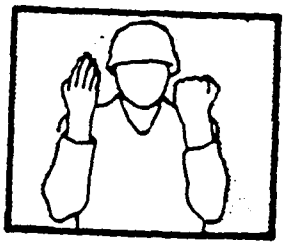
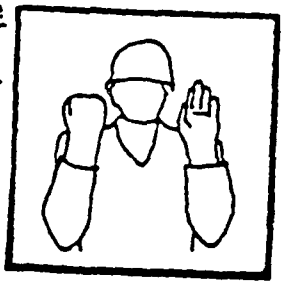
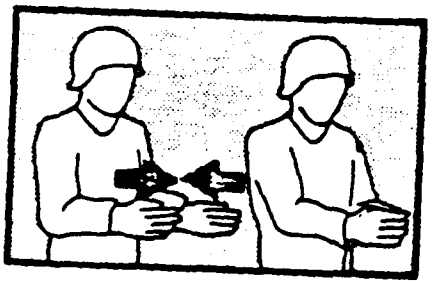
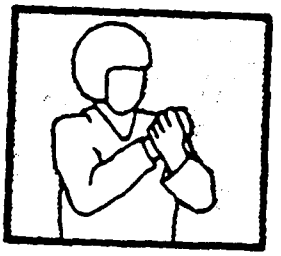
SCORESHEET

USE VISUAL SIGNALS TO CONTROL MOVEMENT (MOUNTED)

INSTRUCTIONS TO SOLDIER: During this test you must demonstrate your ability to give visual signals to a tank driver. I will announce to you the signal then you respond by demonstrating the appropriate hand and arm signals. You will have 10 seconds to give each signal. The following signals are used during daylight hours. Give the signal for: _____.

PERFORMANCE MEASURES:		GO	NO-GO	COMMENTS
A. Stop Engine				
1. Draw right hand, palm down, across neck.		___	___	_____
B. Move Forward				
2. Moved hands backwards and forwards, palms toward chest.		___	___	_____
C. Move in Reverse				
3. Moved hands backwards and forwards, palms away from chest.		___	___	_____

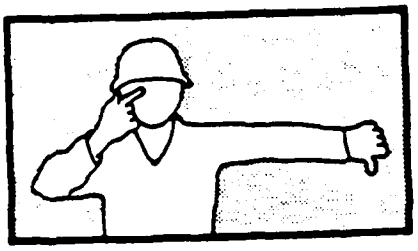
PERFORMANCE MEASURES:

	GO	NO-GO	COMMENTS
D. Left Turn			
4. Moved right arm back and forth, palm toward chest. 	___	___	_____
E. Right Turn - Reverse			
5. Moved left arm back and forth, palm away from chest. 	___	___	_____
F. Close Up Distance			
6. Brought palms together. 	___	___	_____
G. Stop			
7. Clasped hands together at chin level. 	___	___	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS

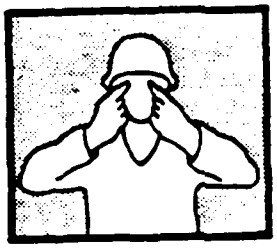
H. Lights Off

8. Index finger at right hand pointed toward eye; signaled thumb down with left hand. ____ ____ _____



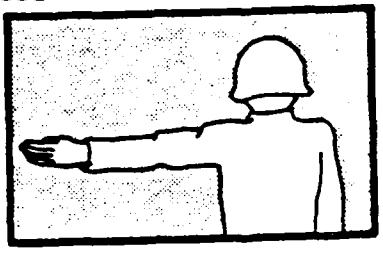
I. Lights On

9. Pointed index fingers on both hands toward eyes. ____ ____ _____



J. Left Turn - Mounted

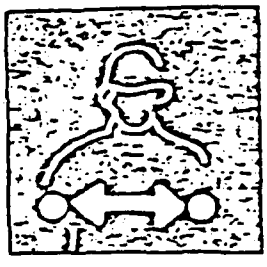
10. Palm faced to front. ____ ____ _____



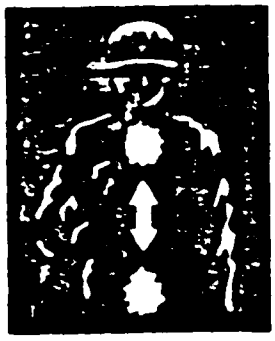
NOTE TO SCORER: Give flashlight to soldier. Say: These signals are to be performed as though it is night. Give the signal for: _____.

K. Stop

11. Moved light horizontally back and forth across path of vehicle. ____ ____ _____



PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
L. Increase Speed			
12. Moved light up and down in front of body.	___	___	_____



M. Left Turn			
13. Rotated flashlight counterclockwise.	___	___	_____

INSTRUCTIONS TO SOLDIER: For the remainder of the signals, my assistant will give you a signal. You must identify the signal or tell what you would do when you received the signal. You will have 10 seconds to respond to each signal.

N. Disregard			
14. Identified as Disregard, or As You Were or stated he would ignore previous signal.	___	___	_____
O. Advance			
15. Identified as Advance or Move Out or stated he would move tank forward.	___	___	_____
P. Column			
16. Identified a Column or stated he would go into column formation.	___	___	_____
Q. Wedge			
17. Identified as Wedge or stated he would go into wedge formation.	___	___	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
R. Echelon Right			
18. Identified as Echelon Right.	___	___	_____
NOTE TO SCORER: Soldier must identify direction as Right.			
S. Line			
19. Identified as Line or stated he would go into line formation.	___	___	_____
T. Refuse Left Flank			
20. Identified as Refuse Left Flank.	___	___	_____
NOTE TO SCORER: Soldier must identify direction as Left.			
U. Increase Speed			
21. Identified as Increase Speed or Double Time or stated he would speed up.	___	___	_____
V. Open Up			
22. Identified as Open Up or Extend Distance.	___	___	_____
W. Traveling			
23. Identified as Traveling	___	___	_____
X. Traveling Overwatch			
24. Identified as Traveling Overwatch	___	___	_____
Y. Cover Our Move			
25. Identified as Cover Our Move or stated he would provide overwatch.	___	___	_____
INSTRUCTIONS TO SOLDIER: The rest of the signals will be Flag signals. Again you will have 5 seconds to respond.			
Z. Move Up On Right			
26. Identified Move Up On Right or Stated he would move to the right of the vehicle.	___	___	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
AA. Enemy in Sight			
27. Identified as Enemy in Sight or Danger.	____	____	_____
BB. Move Out			
28. Identified as Move Out or stated he would move forward.	____	____	_____
CC. NBC Hazard			
29. Identified NBC Hazard or stated he would mask.	____	____	_____
DD. Close			
30. Identified Close or Assembly.	____	____	_____

Scorer: _____ Soldier: _____

Date: _____ SSAN: _____

SCORESHEET

IDENTIFY FRIENDLY AND THREAT
ARMORED VEHICLES

INSTRUCTIONS TO SOLDIER: During this test I will show you pictures of both friendly and threat armored vehicles. You will see the vehicles as they would look through binoculars at 1000 meters. You must first identify each vehicle as either friend or threat and then give me the nomenclature. You will have 8 seconds to look at the vehicle and give me the information.

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
A. BMP 1 (oblique right)			
1. Identified THREAT.	____	____	_____
2. Identified BMP.	____	____	_____
B. BTR 60 P (oblique right)			
3. Identified THREAT.	____	____	_____
4. Identified BTR.	____	____	_____
C. M1 (oblique right)			
5. Identified FRIEND.	____	____	_____
6. Identified M1.	____	____	_____
D. Leopard (oblique right)			
7. Identified FRIEND.	____	____	_____
8. Identified Leopard.	____	____	_____
E. T-72 (oblique left)			
9. Identified THREAT.	____	____	_____
10. Identified T-72.	____	____	_____
F. M60 (oblique left)			
11. Identified FRIEND.	____	____	_____
12. Identified M60.	____	____	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
G. T-72 (front)			
13. Identified THREAT.	____	____	_____
14. Identified T-72.	____	____	_____
H. M60 (front)	____	____	_____
15. Identified FRIEND.	____	____	_____
16. Identified M60.	____	____	_____
I. M109 (front)			
17. Identified FRIEND.	____	____	_____
18. Identified M109.	____	____	_____
J. BMD (front)			
19. Identified THREAT.	____	____	_____
20. Identified BMD.	____	____	_____
K. BRDM-2 (oblique left)			
21. Identified THREAT.	____	____	_____
22. Identified BRDM.	____	____	_____
L. Centurion (front)			
23. Identified FRIEND.	____	____	_____
24. Identified Centurion.	____	____	_____

NOTE TO SCORER: At this point, give the soldier about a one minute break, then continue with the next batch of cards.

M. Gepard (oblique right)			
25. Identified FRIEND.	____	____	_____
26. Identified Gepard.	____	____	_____
N. BRDM-2 (front)			
27. Identified THREAT.	____	____	_____
28. Identified BRDM.	____	____	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
O. SP-74 (oblique right)			
29. Identified THREAT.	____	____	_____
30. Identified SP-74.	____	____	_____
P. Centurion (oblique left)			
31. Identified FRIEND.	____	____	_____
32. Identified Centurion.	____	____	_____
Q. ASU-85 (front)			
33. Identified THREAT.	____	____	_____
34. Identified ASU-85.	____	____	_____
R. SP-74 (front)			
35. Identified THREAT.	____	____	_____
36. Identified SP-74.	____	____	_____
S. Gepard (front)			
37. Identified FRIEND.	____	____	_____
38. Identified Gepard.	____	____	_____
T. ASU-85 (oblique left)			
39. Identified THREAT.	____	____	_____
40. Identified ASU-85.	____	____	_____
U. Jagdpanzer (front)			
41. Identified FRIEND.	____	____	_____
42. Identified Jagdpanzer.	____	____	_____
V. T-62 (oblique left)			
43. Identified THREAT.	____	____	_____
44. Identified T-62.	____	____	_____

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
W. Jagdpanzer (oblique right)			
45. Identified FRIEND.	____	____	_____
46. Identified Jagdpanzer.	____	____	_____
X. T-62 (front)			
47. Identified THREAT.	____	____	_____
48. Identified T-62.	____	____	_____

ESTABLISH TANK FIRING POSITIONS

Equipment Required To Set Up Station And Conduct Test

M1 tank
Target vehicle or panel
Stopwatch
2 Crewmembers--loader and driver
Terrain suitable for hull down, turret down and hide positions.

Procedures To Set Up Test Site

1. Position target vehicle or panel approximately 500 meters on the other side of the defilade position.

2. Position vehicle to insure a good hull down, turret down and hide position can be obtained.

Procedures To Be Performed Before Testing Each Soldier

1. Position the tank approximately 50 meters from the hull down location.

Procedures To Conduct And Score Test

Hull Down

1. Soldier may direct the driver to reposition the vehicle until final position is obtained.

2. To score PM 3 and 4, wait until the soldier has selected his final position. Occupy the gunner's seat and check the telescope sight to insure the target is visible. To score PM 4, have the driver back up until the target center mass, as viewed through the telescope, is masked. If the distance moved is more than 4 feet, score PM 4 NO-GO. Have the driver pull up to the original position.

Turret Down

3. To score 6 and 7, occupy the TC position. The target must be visible. To score PM 7, have the driver back toward hide until the center mass of target is no longer visible. If the distance moved is more that 4 feet, score PM 7 NO-GO. Have the driver return to the original position.

Hide Position

4. To score PM 9, occupy the TC position. No portion of the target area should be visible.

Scorer: _____ Soldier: _____

Date: _____ SSAN: _____

SCORESHEET

ESTABLISH TANK FIRING POSITIONS

INSTRUCTIONS TO SOLDIER: During this test you will establish tank positions. During this test you will occupy various tank crew positions. For the first part of the test you will be the tank gunner and must position the tank in a hull down position. You must issue all required instructions to the driver and the loader. After the driver starts the engine, place the turret into power operation.

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS
Hull Down			
Scorer Commands: Driver--Move Out--Gunner-Take Over.			
1. Looked through telescope.	____	____	_____
2. Ordered DRIVER--STOP.	____	____	_____
3. Sight cleared crest of defilade.	____	____	_____
4. Obtained maximum hull defilade.	____	____	_____
Time to occupy Hull Down:	_____		
Turret Down			
INSTRUCTIONS TO SOLDIER: During this portion of the test you will be the tank commander. You must occupy a turret down position.			
5. Positioned tank.	____	____	_____
6. Maintained observation of target area from turret.	____	____	_____
7. Obtained maximum turret defilade.	____	____	_____
Time to occupy Turret Down: _____.			

PERFORMANCE MEASURES:	GO	NO-GO	COMMENTS

Hide Position

INSTRUCTIONS TO SOLDIER: For this portion of the test you will continue to be the tank commander. You must occupy a hide position.

8. Positioned tank.	____	____	_____
9. Obtained hide position.	____	____	_____

Time to occupy Hide Position: _____.